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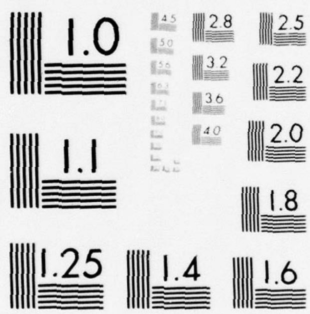

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Joint
Department of Defense
Office of Management and Budget

AIRCRAFT INDUSTRY CAPACITY STUDY

JANUARY 1977

Joint

Department of Defense

Office of Management and Budget

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AIRCRAFT INDUSTRY CAPACITY STUDY.

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CONTENTS

I. EXECUTIVE SUMMARY

At the direction of the Secretary of Defense and the Director, Office of Management and Budget, a joint agency study group was formed on 22 July 1976 to examine the capacity and capacity utilization of the aircraft industry. The study group evaluated existing and planned capacity against present and future military, commercial and foreign market demands. The costs to DoD of maintaining extra capacity were estimated, and the contributions of this extra capacity to national surge and mobilization needs, furthering competition and advancing the technology base were assessed. Finally, the study group identified policy alternatives which might be implemented by the government to achieve a more cost effective balance between industry capacity and likely total demand for peactime and emergencies.

The study addressed eight aspects of the capacity issue:

(1) The capacity of the industry (12 major airplane and 5 helicopter manufacturers) was determined at three different levels of activity and measured by three different activity indicators. The results are displayed in Table 1, together with the current (1975) activity level. Capacity, as considered in this study, is more than the ability to produce based on available plant facilities, tooling, and special equipment. Industry's capacity is also determined by management, engineering staff, and marketing and service organizations as well as production emplovees. Capacity is also related to the ability to overcome selected choke points resulting from equipment or tooling limitations and scarce skill levels. The study found that the cost of manpower supporting the current industry structure (rather than extra plant and equipment) provides the greatest impact when considering the cost of extra capacity.

TABLE 1

CAPACITY[a]

Alternate Capacity Levels	Employment (thousand)	Sales (billion 1976 $)	Output[b] (lb of airframe, millions)
Nominal One-shift (1 shift - 40-hour week)	360	19	100
"Peak" Corporate Experiences (1.4 shifts - 40-hour week)	470	25	125
Mobilization (3 shifts - 48-hour week)	990	53	240
Actual Performance (1975)	210	11	50

[a]Excludes general aviation.

[b]This output measure is essentially the empty weight of all aircraft produced, less engines and certain mission equipment.

Different levels of aircraft industry output generally can be achieved with existing facilities by increasing or reducing employment up to a finite facility limit. Three different levels are defined. The *"Peak" Corporate Experiences* level represents the output the industry has recently demonstrated it can achieve effectively. This level is the sum of the peak outputs of each of the firms in its most productive year between 1960 and 1975. The *Nominal* (1 shift, 40-hour week) and *Mobilization* (3 shifts, 48-hour week) levels are computed from the actual corporate peaks assuming higher or lower employment shift ratios and adjusting for floor space changes since that peak. The *Mobilization* level is the maximum attainable output of current facilities.

Airframe weight was found to be the best of the three indicators of industry output, although the relative variation among the three was small. The primary measure of industry capacity used throughout

the study has been *"Peak" Corporate Experiences,* as indicated by the weight of aircraft produced. The *"Peak" Corporate Experiences* level was selected because it reflects what the industry firms actually have produced in the recent past, and is consistent with the "optimum" utilization of plant and equipment on a slightly greater than one shift basis.

(2) Demand for future industry output was projected in terms of domestic and foreign sales of civil and military aircraft, using internal Department of Defense planning projections, FAA projections, and commercial forecasts. Confidence in the accuracy of the total demand projection is affected by substantial uncertainties related to the magnitude and timing of major new acquisitions such as tanker/bomber procurements and commercial fleet replacements, fluctuation in foreign military sales and the inability of the projected DoD procurement levels to maintain the current aircraft force structure size and age. These uncertainties are examined in greater detail in Section II.H together with variations in the demand projections; however, their overall effect is believed to be in the range of ±25 percent and not to change the study findings significantly.

The nominal values of these demand projections are displayed in Figure 1, together with historical industry experience, and are compared to current capacity at the three selected levels of activity.

Total demand for aircraft is projected to fall through 1980, then to increase primarily due to an improvement in the commercial transport market. The demand is weighted heavily toward transport aircraft because of scheduled replacement of large segments of the civil fleet and because military cargo aircraft are projected to make up almost half of all military demand from 1983 through 1990, compared to less than 20 percent in the 1970s.

Compared to recently demonstrated "peak" performance (the equivalent of about 1.4 shifts) and excluding the general aviation sector, the aircraft industry currently has the capacity to produce approximately twice the projected demand. At the mobilization capacity level of 3 full shifts, the industry could produce more than 4 times the projected peacetime demand, provided certain "choke" points were eliminated. These choke points vary by

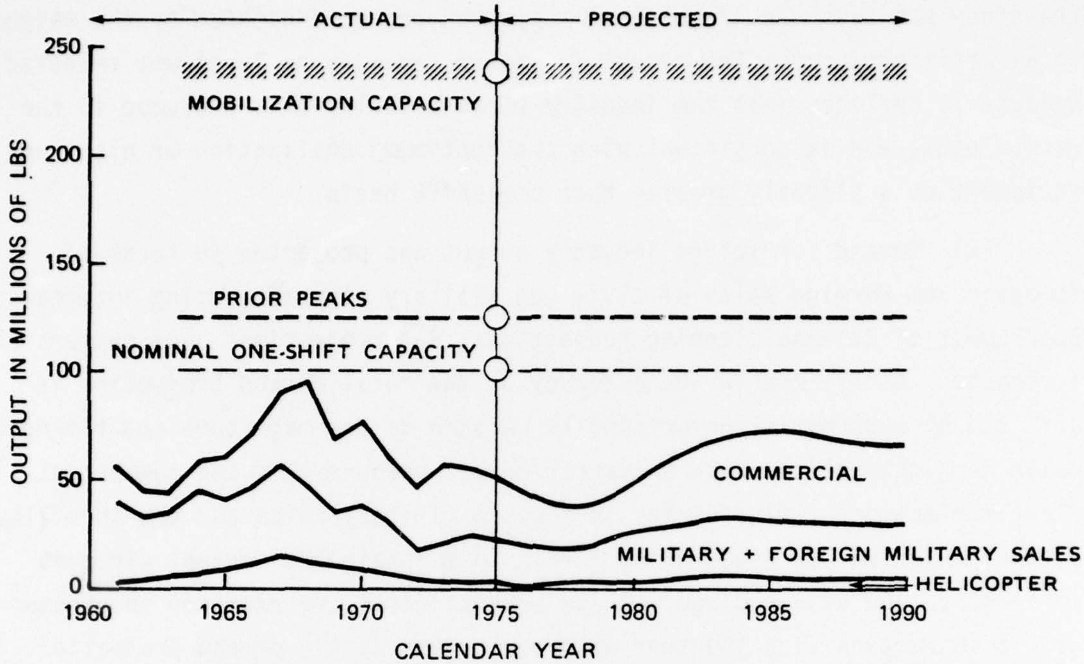

FIGURE 1. CAPACITY UTILIZATION, U.S. AIRCRAFT INDUSTRY OUTPUT, 1961 – 1990

model type and producer and include such items as numerically controlled machines, large forgings, and engines.

(3) Extra capacity is defined herein as the difference between what the industry has demonstrated recently it can produce and what it is now producing. Based on present military and commercial demand, there is extra capacity of over 50 percent. Extra capacity is projected to increase to 65 to 70 percent in 1977 through 1980, then fall to about 45 to 50 percent in the 1980s if production physical capacity (plants and equipment) remains unchanged (including no productivity enhancements).

(4) The DoD share of annual costs to maintain extra capacity involves both budgetary and non-budgetary costs. In recognition of the uncertainty of cost estimating methodologies, cost estimates have been derived using several different techniques. In each of the approaches used, the DoD share of the capacity costs was concluded to be proportional to DoD's share of total

industry sales. Estimates were made for the total cost of extra capacity to DoD and for several subsets of total cost. The cost subsets are not necessarily cumulative.

- The best estimates of annual total cost to DoD of the current level of extra capacity in the aircraft industry is $300-500 million. This cost will increase from the mid-point estimate of $400 million per year currently to about $450 million per year in the period 1978-1980 and then decrease to $250-300 million per year by 1982 (productivity increases would naturally raise this figure significantly).
- The major costs associated with extra capacity relate to employment supporting the current industry structure and these costs, representing 18-20 thousand employees, are on the order of $250-400 million per year to DoD.
- Capital costs of plants and equipment in excess of needs are about $80 million annually; a portion of this cost is not directly budgeted.
- A significant cost burden relates to maintaining more vertically integrated product centers than required for projected demands or competitive reasons. These extra costs are about $250-400 million if the number of plants could be reduced proportionate to extra capacity. Reduction of the number of plants by not more than one-third in order to sustain a fully competitive structure in each separate sector of the industry would result in cost savings estimated to be $150-250 million annually.
- Procurement of aircraft at inefficient low production rates that maintain a warm production base is estimated to cost between $150-250 million per year (based on quotations from current programs).

(5) Several benefits from extra capacity were identified:

- The ability of industry to surge to maintain programmed aircraft inventories at force structure levels was examined for a severe wartime attrition scenario. Assuming a 1-year warning with appropriate mobilization actions, existing warm production lines would begin to compensate partially for losses in 18 to 24 months for airplanes and 12 to 18 months for helicopters.
- The benefits of competition are substantial but not easily quantifiable. The technical superiority of U.S. aircraft has resulted in part from the competitive structure of the industry. The competition-derived benefits of lower acquisition and operations and support costs work to offset the costs of bearing extra capacity. Favorable competitive forces occur primarily in the development phase, with some competition occurring during production when subcontracting between major firms generates cost competition.

- Extra capacity provides flexibility in plant layout and in alleviating production problems.

(6) The following policy alternatives, discussed in Chapter III, were considered, including the pros and cons which might result from their implementation:

- Continue current aircraft procurement practices with evolutionary improvements.
- Allow more free market operation with the intent of reducing extra market capacity.
- Establish acquisition procedures which encourage consolidation and contraction of the industry.
- Mandate a rigorous policy of procuring aircraft at efficient production rates through DSARC or other decision processes; buy out or terminate low rate production.
- Deliberately phase military aircraft developments and procurements to avoid large industry buildups and drawdowns.
- Augment demand on the private sector of the industry by shifting activity from military depots to private industry.
- Reduce active extra capacity of industry by mothballing or closing several government-owned plants or product centers.
- Achieve modernization and work force stabilization of selected facilities.

(7) The impacts and estimated difficulty of implementing policy alternatives are different for the various alternatives considered. Not all policy alternatives are mutually exclusive. The correct course for the government to follow is likely to be a combination of alternatives, with different ones applicable to the various market sectors. Actual annual savings that might be obtained five years hence were judged to be about $250 million, or a little more than half the present costs of extra capacity. The impact of some actions such as plant closings, production line accelerations and transfer of work from government depots to industry would increase near-term costs but lay the groundwork for subsequent cost savings. The impact of other alternatives would reduce near-term costs.

The study group attempted to assess the difficulty of implementing the various policy alternatives and to quantify the potential savings if each

one, or a combination of the alternatives were successfully pursued. These assessments are described in Section III.D.

(8) The study postulated, for subsequent examination, potential implementation actions for immediate, near-term, programmatic, and long-range enactment. These postulated actions are:

IMMEDIATE

- Release report of study to industry.
- Establish DoD resource planning group for follow-up action on this and other defense industrial base studies.

NEAR-TERM

- Terminate, or efficiently buy out and then terminate, low-rate production programs.
- Limit maximum allowable overhead rates on contracts.
- Disapprove further plant expansions.
- Close or mothball several government-owned product centers.
- Postpone or redirect currently planned overlapping developments.
- Identify selected depots to be closed and transfer the displaced work to private industry.
- Remove critical choke points to surge capability.

PROGRAMMATIC

- Phase programs in each sector so as to smooth aircraft procurement variations.
- Plan production rate changes to minimize work force turbulence.
- Consider production site/facility factors during competitive development phase planning.
- Review procurement plans early in the development phase to improve facilities utilization and to insure efficient industry production labor loading.
- Limit award of prime production contracts and major subcontracts to firms with viable facility, tooling, and management assets.

LONG-TERM

- Institutionalize systematic aircraft industry resource planning.
- Take procurement and policy actions to promote desired industry contractions.

- Establish specialized suppliers for critical or high technology components or materials.
- Assess the potential benefits of producing military aircraft in selected, highly modernized, fully-loaded aircraft plants.

II. AIRCRAFT INDUSTRY CAPACITY STUDY

A. INTRODUCTION

This study assesses the capacity of the U.S. aircraft industry to manufacture fixed-wing aircraft and helicopters. It examines production capacity and costs under peacetime surge and mobilization conditions and compares this with past, present and projected demand. The study explores advantages and disadvantages of feasible alternatives for maintaining a cost-effective balance between capacity and demand.

Twelve major aircraft and five helicopter prime contractors are examined. The study does not examine engines, avionics, or any other components that are not directly related to airframes.

This effort has been conducted by staff representatives from the Department of Defense and the Office of Management and Budget with assistance from the Departments of Commerce and Transportation. Data collection and analysis have been performed by System Planning Corporation under contract to the Office of the Assistant Secretary of Defense (Installations and Logistics).

The report is organized into three Chapters. Chapter I contains an Executive Summary. Chapter II assesses the current industry capacity and its relation to projected demands. Major topics in Chapter II include:

- The capacity of the industry to produce aircraft compared to present and expected future demand for defense production, foreign military sales, and commercial business.
- Extra capacity in the industry above that needed to satisfy present and expected future peacetime demand, and the Department of Defense share of the costs that can be associated with extra capacity.

- The contribution of extra capacity to surge or mobilization production, increased competition and improved technology.
- Major uncertainties in the study data and the special characteristics of the general aviation sector.

Chapter III lists eight policy alternatives that DoD could adopt toward extra industry capacity, describes the characteristics and major defense programs of the four sectors, examines the pros and cons of each alternative as it applies to the industry sectors, estimates the future annual savings associated with each alternative five years hence, and judges feasibility of implementation. There are also a number of government actions that are identified for possible implementation.

B. INDUSTRY CAPACITY MEASURES

Different levels of aircraft industry output can be achieved with existing or planned facilities and tooling by increasing or reducing employment. This study uses three different measures of capacity. These measures are:

- Nominal One-Shift Capacity (1 shift, 40-hour week): The industry output achievable with planned tooling when the 17 firms operate at an employment level equal to the first shift headcount in each firm's maximum year between 1960 and 1975.
- "Peak" Corporate Experiences (1.4 shifts, 40-hour week): The industry aggregate for all firms of the peak output of each firm in its most productive year between 1960 and 1975. This approximates the most economic activity level of the industry as now structured. However, this activity level involves stresses on individual plants and for them may not be the most economic level. The individual firms' production peaks did not necessarily occur in the same year. More than half occurred between 1967 and 1969.
- Mobilization Capacity (3 full shifts, 48-hour week): The output of the industry with the tooling and facilities on hand or planned, assuming firms operate at maximum employment (3 full shifts).

Any one of these output measures could be an appropriate indicator of capacity. For study purposes, "peak" corporate experience was selected as a primary measure because it represents the level of output the industry has demonstrated recently that it can achieve effectively. For comparative purposes, this study shows all three measures of capacities. However,

conclusions are based upon the "peak" corporate experiences activity level. This activity level is a good measure of peacetime surge capability. The other two measures of capacity are computed by adjusting the actual corporate peaks for changes in facilities and by assuming a higher or lower employment shift rate.

Three capacity indicators in terms of employment, sales, and output are displayed in Table 1 (page 4). For comparison, the current (1975) activity level is also displayed. The peak, nominal, and mobilization figures are adjusted for floor space and productivity changes since the peaks occurred. Each of the indices has drawbacks:

Employment is an indicator of input that reflects the total manufacturing efforts of the firms examined. While employment has the advantage that it does not double-count for subcontracted components, as does sales, employment has the disadvantage that it does not reveal increased (or decreased) labor productivity, nor does it reflect subcontracted effort outside the 17 firms.

Sales is an indicator of output that also reflects total manufacturing efforts of the 17 primes including spares, modifications and overhaul work. Sales has the disadvantage of double-counting work subcontracted among the 17 firms. Further, the rate of subcontracting by the major prime contractors varies from somewhat higher levels during periods of high demand to lower levels in periods of reduced demand, thus introducing additional distortions in the comparability of data over time. Finally, sales are expressed in current or inflated dollars and must be converted to constant dollars for meaningful comparison. Since knowledge of price movements in this industry is imperfect, any deflator chosen is subject to uncertainty. This study shows sales in constant dollars deflated by an Air Force index that is specifically related to airframe price changes.[1]

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[1]Prepared by J. Watson Noah Associates. These factors for 1960-76 are: 260, 251, 244, 237, 230, 208, 220, 198, 187, 174, 162, 154, 143, 136, 118, 108, 100.

Aeronautical Manufacturers' Planning Report (AMPR) weight is an indicator of output that reflects the actual production of airframe contractors. AMPR weight is essentially the aircraft contractors' manufactured weight, or the aircraft weight empty minus engines, weapons, and most mission equipment. Since virtually all U.S. firms producing aircraft are included in the 17 firms examined, AMPR weight approximates the total output of the industry. Spares, modifications and overhaul work are not included. AMPR weight somewhat overstates the value of very large aircraft (such as the 747s, C-5As, and Advanced Tanker/Cargo Aircraft (ATCAs)); overstates the value of unsophisticated general aviation aircraft; and understates the value of the more sophisticated fighter/attack and specialized aircraft. An advantage of AMPR weight is that it is a "real" indicator of output and does not have to be converted to a constant value as does sales.

While the study displays all three indicators for current conditions, projections are expressed in terms of AMPR weight, again because AMPR weight is an index of output that measures the entire industry. While AMPR weight is the best measure of total industry output, it is not a good indicator of individual firm performance since the entire AMPR weight is assigned to the manufacturer of the finished airplane and substantial engineering, spares, production, and other activities are not measured.

The mobilization capacity figure was developed using two different approaches. One estimate is based upon the peak performances of each of the firms in their most productive year. These data are then adjusted upward (from the employment shift rate experienced by each firm in its most productive year) to a full 3-shift, 48 hour per week rate. The other estimate is based upon present floor space, and the actual industry peak annual AMPR weight produced per employee: 270 pounds for airplanes and 350 pounds for helicopters.

Table 2 displays employment, sales and AMPR data by company for each firm's peak year and compares these figures with their 1975/76 performance. The firms are grouped into three categories: military and commercial aircraft, helicopters, and general aviation. Table 3 presents a product specialization pattern of the industry by type of aircraft and shows the

TABLE 2

1975/6 PERFORMANCE VS PEAK

Firm[a]	PEAK Year	PEAK Empl.	PEAK Sales $M	PEAK AMPR 10^6 lb	1975/6 1976 Empl.	1975/6 1975 Sales $M	1975/6 1975 AMPR 10^6 lb	FLOOR SPACE 1975 10^6 ft^2	FLOOR SPACE % Change From Peak
Military and Commercial Aircraft									
A	1972	28,000	1,400	9.0	14,000	900	6.2	9.6	-11
B	1969	33,000	2,000	15.0	9,900	570	3.7	7.8	-11
E	1960	15,000[b]	760	3.1	6,800	80	0.0	6.0	-10
F	1962	20,000	850[b]	3.1	5,000	150[b]	0.3	3.0	-23
G	1967	110,000	5,700	32.0	43,000	2,800	14.0	21.0	-16
I	1968	30,000	2,300	3.9	6,700	140	0.3	6.5	0
J	1968	98,000	4,100	39.0	34,000	2,200	19.0	23.0	-20
K	1974	11,000	640	1.7	11,000	580	1.7	2.9	0
L	1963	31,000	1,200[b]	1.1	15,000	440[b]	0.4	8.0	- 8
M	1969	27,000	1,000	3.6	9,800	470	0.9	6.4	- 5
N	1968	29,000	1,400[b]	2.6	23,000	1,100[b]	2.7	7.5	- 3
Subtotal		430,000	22,000	115.0	180,000	9,800	49.0	100.0	-12
Helicopters									
O	1968	10,000	500[b]	2.8[b]	6,000	300[b]	0.8[b]	2.0[b]	0
P	1969	11,000	960	6.6	9,200	660[b]	3.0	2.4	+40
Q	1962	3,400	180	0.6	1,000	40	0.0	0.9	-24
R	1967	13,000	800	4.5	5,900	210	0.4	2.2	-29
S	1969	5,000	160	0.8	1,800	90	0.3	0.6	-70
Subtotal		43,000	2,600	15.0	24,000	1,300	4.5	8.1	-15
General Aviation									
C	1973	6,000	220	2.2	5,500	200	1.6	1.9	0
D	1975	9,600	560	6.8	9,600	560	6.8	3.6	0
H	1968	12,000	310	3.3	7,700	250	2.1	2.4[b]	0[b]
Subtotal		28,000	1,100	12.0	22,000	1,000	10,0	7.9	0
Total		500,000	26,000	142.0	225,000	12,000	63.0	116.0	-11

[a]Two product centers are listed for two manufacturers.

[b]Estimated.

Sales are expressed in 1976 dollars.

"Year" refers to peak employment year; peak AMPR or sales year is within 1-2 years of this peak.

TABLE 3

COMPETITION IN THE AIRCRAFT INDUSTRY

	1960			1968			1976		
Fighter/ Attack	Lockheed Convair Douglas McDonnell Vought	Republic Northrop Grumman Rockwell-LA Rockwell-Columbus	(10)	Douglas McDonnell Vought Republic GD/Ft. Worth	Northrop Grumman Rockwell-LA Rockwell-Columbus	(9)	MACDAC Vought Fairchild	Northrop GD/Ft. Worth Grumman	(6)
Bomber	Boeing GD/FT. Worth Rockwell	Lockheed Douglas	(5)	Boeing GD/Ft. Worth Rockwell		(3)	Boeing GD/Ft. Worth Rockwell		(3)
Military Transport	Boeing Lockheed Douglas	Fairchild Grumman Convair	(6)	Boeing Lockheed Douglas		(3)	Boeing Lockheed MACDAC		(3)
Commercial Transport	Boeing Douglas Lockheed	Fairchild Convair	(5)	Boeing Douglas Lockheed		(3)	Boeing MACDAC Lockheed		(3)
Helicopter	Boeing Lockheed Bell Sikorsky Hughes	Kaman Hiller Gyrodyne Cessna	(9)	Boeing Lockheed Bell Sikorsky	Hughes Kaman Hiller	(7)	Boeing Bell Hughes	Sikorsky Kaman	(5)

Number of companies in each category in parentheses

number of firms producing aircraft of each type. It is interesting that between 1960 and 1968--a period of increasing industry demand--considerable consolidation occurred, while between 1968 and 1976--a period of slackening industry demand--about half as much consolidation took place.

C. DEMAND

Historical demand in AMPR weight terms, shown in Figure 2, has varied between lows of 44 million pounds in 1963 and 1972 to a high of 92 million pounds in 1968. Total demand is projected to fall to approximately 40 million pounds in 1978, increase to 60 million pounds in the early 1980s and rise to an average of 70 million pounds during the mid-1980s.

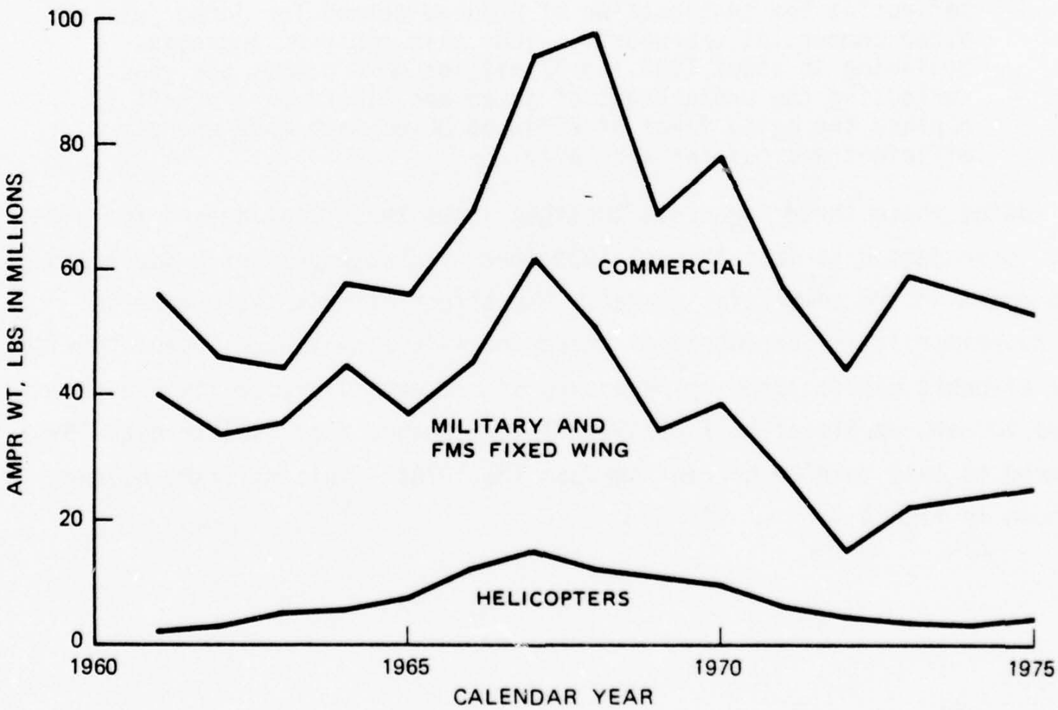


FIGURE 2. U.S. AIRCRAFT PRODUCTION, 1961 – 1975

Demand projections are based upon the following:

- Helicopters: Military and foreign military sales are based upon Defense Department planning data, while commercial projections are based upon FAA estimates. The projection increases from an average of 3 million AMPR pounds per year over the next five years to a level of 5.5 million AMPR pounds from 1981 on. This compares with a peak of 14.8 million AMPR pounds for 1967. Past and projected helicopter sales are presented in Figure 3.

- Military and Foreign Military Airplane Sales: Defense Department planning data are smoothed and show a near-term reduction in military demand from a 1967 peak of 42.7 million AMPR pounds to approximately 20 million AMPR pounds per year. The annual demand increases to an average of 26 million AMPR pounds in the 1983 to 1990 period. Sales of foreign military aircraft are assumed constant in the period 1979-1990.

- Commercial Aircraft: FAA and private forecasts show a dip in demand to 20 million AMPR pounds through the late 1970s reflecting the continuation of reduced demand for jumbo jets and other commercial transports. They also imply an increase, beginning in about 1980, to 37 million AMPR pounds per year reflecting the procurement of jumbo and other new aircraft to replace the aging fleet of 707s and DC-8s with more energy efficient and quieter aircraft.

Adding these three forecasts together shows that total demand for aircraft is projected to fall through 1980, then increase primarily due to an improvement in the commercial market. The effect of this preference in demand--primarily for producers of transports--is accentuated because military cargo aircraft manufactured by producers of commercial transports are projected to make up almost half of all military output from 1983 through 1990, compared to less than 20 percent through the 1970s. This military balance is shown in Figure 4.

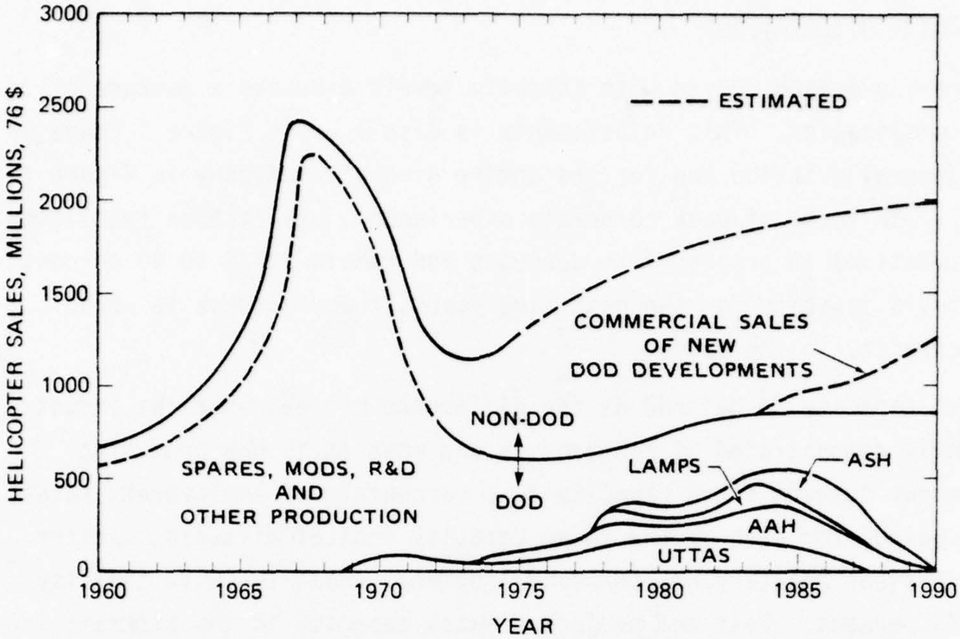


FIGURE 3. HELICOPTER SALES PROJECTION (ENGINES, WEAPONS, AND GFE AVIONICS EXCLUDED)

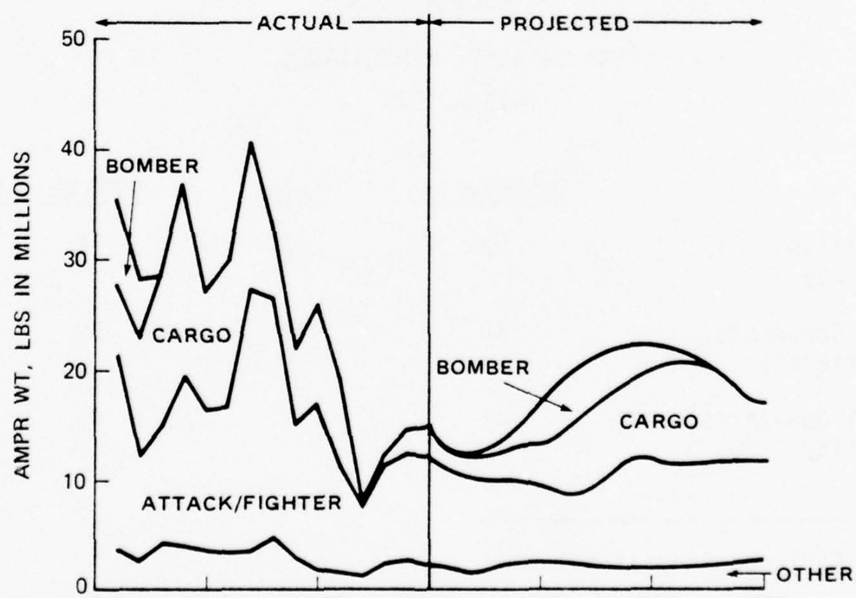


FIGURE 4. DEMAND, DoD FIXED WING AIRCRAFT, 1961-1990

D. CAPACITY UTILIZATION

Comparing demand curves with capacity levels provides a picture of capacity utilization. This relationship is displayed in Figure 1 (page 6) without general aviation and for the entire aircraft industry in Figure 10 (page 38). In terms of peak corporate experiences, utilization (excluding general aviation) is projected to decrease and remain at 35 to 40 percent of industry's capacity for the next five years, then increase to about half of capacity in the 1980s.

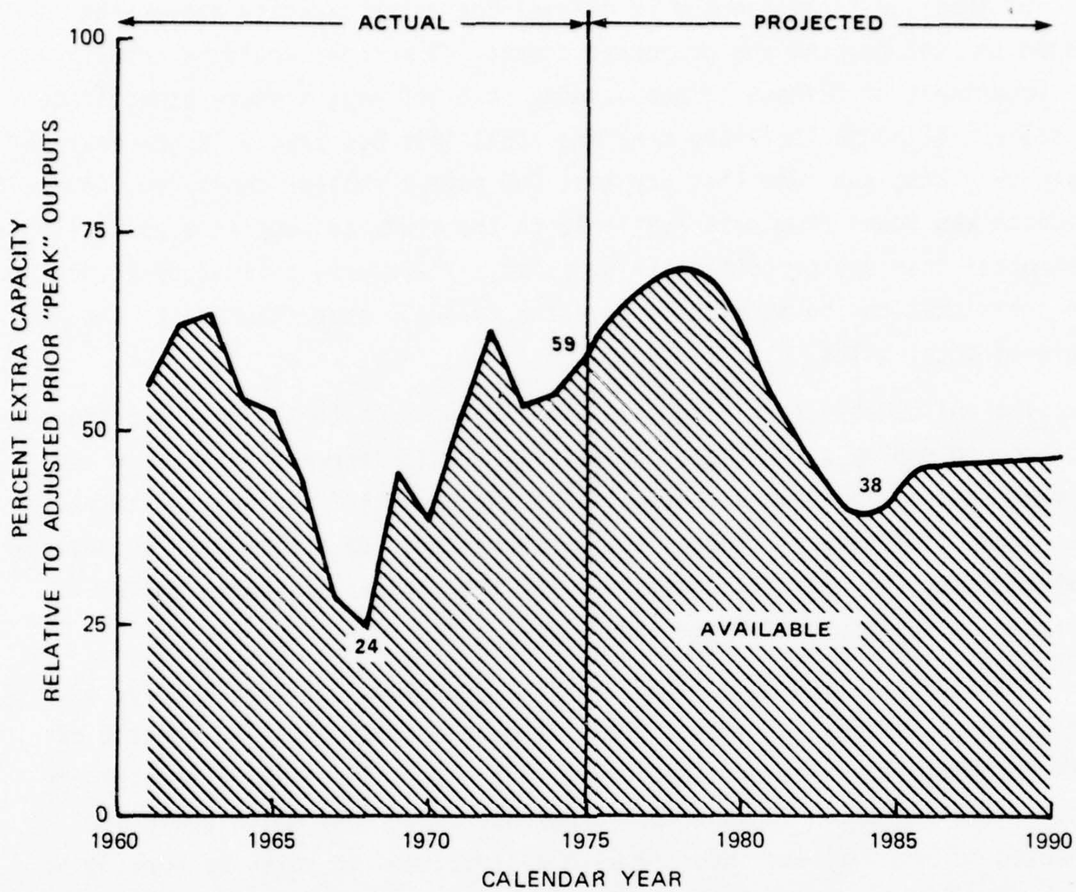
Extra capacity is defined as the difference between what the industry has recently demonstrated it can produce and what it is now producing. Table 4 shows current extra capacity as a percentage of employment, sales, and AMPR weight for each of the three capacity indices discussed earlier. Based on present military and commercial demand, there is extra capacity of over 50 percent. Past and projected extra capacity in the aircraft industry is presented in Figure 5.

TABLE 4

EXTRA CAPACITY PERCENTAGES
1975 - 1976

	Employment	Sales	AMPR Weight
Mobilization Capacity	80	80	76
"Peak" Corporate Experiences	57	56	59
Nominal One-Shift Capacity	44	42	45

Note: Excludes General Aviation.



NOTE: Excludes General Aviation

FIGURE 5. EXTRA CAPACITY RELATIVE TO ADJUSTED PRIOR "PEAK" OUTPUTS

E. DoD SHARE OF THE COSTS OF EXTRA CAPACITY

Historically, military aircraft production has accounted for as much as three-fourths of total industry sales. However, the current and projected demands for aircraft indicate that the defense share of the market is projected on average to be no larger than the present 47 percent in terms of sales and 30 to 35 percent in terms of AMPR weight.

Of those costs attributed to maintaining extra capacity above that needed to meet present and projected demand, 47 percent would be borne by the Department of Defense if one assumes that DoD pays a share proportionate to sales. Although there are many arguments that DoD pays a larger share of capacity costs, and some that say that DoD pays a smaller share, no convincing evidence was found from data available to the study to support a cost allocation other than one proportionate to sales. Therefore, this study allocates the costs that can be attributed to extra capacity proportionate to the DoD share of total sales.

The philosophy underlying this study's approach to the cost question has been to employ a variety of relatively straightforward methods in order to make several independent estimates of the potential savings. Data has been drawn from several sources and cross checked for accuracy to a substantial degree. The relative consistency of the various estimates can be regarded as a measure of their accuracy.

These calculations are based on data displayed in Figure 1 (page 6) which indicates that the industry operated at approximately 40 percent of peak corporate capacity utilization in 1975. On this basis, estimates are made of the reduction in cost to the Defense Department which could be expected to occur if the industry were restructured so as to be working at a capacity level equal to the previously defined peak corporate experience level, i.e., about 1.4 shifts.

The data and available costing methodologies provided a basis for estimating both total costs of capacity as well as significant subsets. The major subsets are cost of employment, number of vertically structured firms or product centers, plant and equipment, and the cost of maintaining low rate, warm production lines. These cost categories are not strictly cumulative and are separately identified to provide a focus for subsequent cost reduction considerations.

Employment is a major cost component of the aircraft industry, and employment costs are partially determined by the current industry structure. In general, the ratio of indirect to direct employment has varied inversely with the level of constant dollar sales. Also, there is a general trend of increasing numbers of indirect workers relative to direct workers in all

U.S. manufacturing industries as technological innovations lead to greater productivity increases for production workers than for indirect workers. Both these trends are reflected in Table 5.

TABLE 5

PRODUCTION AND NONPRODUCTION EMPLOYMENT IN THE AIRCRAFT INDUSTRY

Year	Number of Airframe Production Employees (1000s)	Number of Airframe Nonproduction Employees (1000s)	Ratio of Nonproduction to Production Employees	Constant Dollar Sales ($billions)
1961	155	125	0.81	12.3
1962	155	141	0.91	12.4
1963	152	137	0.90	10.7
1964	155	126	0.81	11.3
1965	162	129	0.80	12.0
1966	215	158	0.73	15.8
1967	244	175	0.72	18.8
1968	248	182	0.73	21.4
1969	221	175	0.79	18.2
1970	168	147	0.88	17.0
1971	131	125	0.95	14.0
1972	127	120	0.94	11.0
1973	127	121	0.95	12.6
1974	125	120	0.96	12.3
1975	114	121	1.06	12.1

Source: Employment data was drawn from Aerospace Facts and Figures 1976/77. Sales are from data provided by the aircraft companies.

In the peak employment years of 1966 to 1969, the industry operated at an average ratio of 0.75 nonproduction employees for every production worker. Ignoring relative productivity changes for the moment, this compares with a ratio of 0.80 to 0.90 in the lower activity levels between 1961 and 1964 and 0.95 to 1.06 in the low capacity utilization years of 1973-1975.

Converting the 1966-1969 ratios to a 1975 figure and adjusting for productivity changes since that time, the average figure of 0.75 becomes 0.81 in 1975. This productivity adjustment assumes that the industry average

productivity growth[1] was 1.8 percent annually and that productivity growth was twice as high for production workers as for nonproduction employees.

If this 0.81 ratio had prevailed in 1975, total aircraft employment for the 17 firms studied would be 12.2 percent less. Labor costs, exclusive of subcontractor labor, average about 40 percent of total costs in the aircraft industry. Based on 1975 DoD sales of $5.5 billion, the labor cost to DoD was about $2.2 billion. Applying the 12.2-percent reduction to this figure suggests that the extra labor cost to DoD was about $270 million. Non-labor in-house costs (depreciation, insurance, profit, etc.) typically are 50 percent of prime labor costs, so that if these costs have experienced the same trend, the total extra capacity costs would be approximately $400 million.

Another approach to estimating the cost of extra capacity related employment is to attempt to estimate the number of "fixed" employees in the industry as now structured. A linear regression model was evaluated in which employment, E, for a firm was set equal to two terms, a constant plus a coefficient multiplied by the sales, S, of the firm. The model was regressed over sales and employment data provided to System Planning Corporation by 11 airplane product centers for 8 different years (1961, 65, 68, 70, 72, 73, 74, 75), using a separate statistical regression for each year. This analysis showed that, on an average, the predicted sustaining or "door opening" number of employees per firm for the manufacture of airplanes is 2,700 people, with a 95-percent probability that the number is less than 5,000.

The regression for 1975 was close to the average for the 8 years:

$$E = 3{,}036 + 15.8\ S$$

$$R^2 = 0.965.$$

A similar regression for the helicopter industry over 4 separate years (1968, 73, 74, and 75) did not provide quite as consistent a fit to the data, but the approach gave an estimate of 1,300 people on average as being the

[1] Five different measurements of productivity were examined ranging between 1.8 percent and 4.5 percent per year. A figure of 1.8 percent, expressing value added divided by payroll, is used in this study as a conservative yet representative measure of prime manufacturers' performance.

"door opening" number of people required. Again, the 1975 regression was close to the average:

$$E = 1{,}140 + 14.6\ S$$
$$R^2 = 0.939.$$

Using \$6.50 per hour, which is the sales-weighted average hourly rate of two-thirds of the industry, and a 40-percent direct fringe benefit loading based on industry data, 2,000 hours per year per employee, 14 product centers, 60 percent underutilized capacity, and a 47-percent DoD sales share yields \$195 million for the fixed-wing aircraft industry. Adding the helicopter industry results in a cost for extra employment of \$230 million. If subcontract employment has similar fixed or semifixed overhead burdens, a total extra employment cost of \$350 million may be the DoD share.

These two estimates display good consistency but have a large uncertainty pertaining to the employment pattern of subcontractors. A significant portion of the industry subcontracting effort is between primes and an assumption of similar employment burdens is reasonable for that portion. However, a larger portion of the effort is with smaller contractors that tend either to adjust more efficiently to market changes or to go out of business. Some, such as aluminum producers and fabricators, have experienced continued high business activity levels independent of aerospace demand. Others, such as many casting suppliers, have left the market in the face of declining demand and costly environmental regulations. It is a best judgment of experienced managers in the industry that subcontractors accommodate to variations in demand more efficiently than do the prime contractors so their fixed employment burden is probably at a more favorable ratio. This would lead to a conclusion that extra employment costs in the industry borne by DoD currently are on the order of \$250-\$400 million.

It is also possible to assess extra labor costs by considering the labor savings that might result from consolidations of plants and facilities. From Table 5, a relationship between nonproduction employment (NPE), production employment (PE) and time (T) can be derived statistically with the following results:

$$NPE = 1.71\ PE^{0.617}\ T^{0.0063}$$

This relationship displays significant statistical correlation.[1] Further, the factor relating production and nonproduction labor is consistent with another statistical analysis performed by the Logistics Management Institute relating overhead costs and direct labor costs using another data base.

These analyses suggest that production and nonproduction labor costs will vary according to the relationship

$$NPE \propto PE^{0.62}.$$

It is shown in Table 5 that NPE and PE were essentially equal in 1975, so equal costs for NPE and PE are a reasonable first order assumption. Of the $5.5 billion 1975 DoD aircraft sales, direct labor costs are between $1.1 billion at the prime contractors and $1.8 billion if subcontractors are included and experienced similar labor relationships.

If we assume that the industry capacity were consolidated to one-half the current level, with the remaining facilities performing at twice their current work level, one could anticipate eventual annual savings in indirect labor costs of

$$\$1.1 \text{ B } (1 - (1/2\ (2)^{0.62})) = \$250 \text{ million}$$

or

$$\$1.8 \text{ B } (1 - (1/2\ (2)^{0.62})) = \$410 \text{ million.}$$

Since capacity and number of firms are not directly related, a 50-percent reduction in number of firms may not be acceptable for competitive reasons even if such a percentage reduction in total capacity were acceptable. These competitive considerations are discussed further below.

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[1] $R^2 = 0.915$, $t_{0.617} = 12$, where t is the ratio of the coefficient to its standard error.

The foregoing estimates in this section support the initial finding that extra labor costs are on the order of $250-$400 million.

Taking in-house non-labor costs (depreciation, insurance, profit, etc.) into account, which are typically half the size of labor costs in the industry, the total cost of extra capacity at the prime level would be 50 percent higher than the extra labor costs. The extra capacity labor cost estimates of $230 million, $250 million, and $270 million derived above would thus suggest total extra capacity costs of $350-$400 million.

The major non-labor cost associated with capacity relates to the cost of owning and maintaining aircraft plants and facilities. These costs contain both budgetary and non-budgetary costs, as will be shown.

Typical costs of leasing factory floor space are about $2 per square foot. Total industry floor space in 1976 is approximately 110 million square feet, not including general aviation. For DoD sales of 47 percent of the industry total, DoD's share of the floor space is 52 million square feet. For the industry operating at about 40 percent of capacity, about 30 million square feet are excess to DoD current requirements. If the annual opportunity cost to the government is $2 per square foot, then this extra floor space costs $60 million. The budgetary cost of this will be less than the $2 opportunity cost, since about one-third of this floor space is government-owned, and depreciation, insurance, local taxes, and certain other costs are not directly budgeted for government-owned plants and facilities. Thus, the budgetary cost will be between 15 to 50 percent lower, depending upon how much government production is done in government plants and how much depreciation and other factors affect that $2 per square foot figure. The brick and mortar cost of the plants thus falls between $35 to $50 million annually.

Equipment must now be added to these brick and mortar costs. The acquisition cost of industry's equipment is about $1.8 billion, based on industry-wide data submitted to SPC. Given 40-percent capacity and 47-percent government share of sales, $500 million of this cost may be allocated to DoD. It is assumed that half of the equipment has already been fully depreciated or is government-owned. Using a typical seven-year depreciation period for

equipment, the annual cost to the Defense Department of this underutilized equipment is on the order of $35 million. The sum total cost of plant and equipment that exceeds DoD's current requirements is, therefore, about $80 million annually.

Another approach to the facilities cost is to look at what it costs the government to keep a government-owned plant modernized or in a readiness state. A recent facilities contract provided $5.2 million of industrial preparedness funds to help support the General Dynamics facility at Air Force Plant No. 4 in Forth Worth, Texas. On a square footage basis, this expenditure is $0.86 per square foot in 1976 dollars. The cost of owning (and depreciating) the plant itself would be substantially more in non-budgetary costs. Based on an industry-wide equivalent underutilized floor space of 65 million square feet (59 percent of 110 million), it would cost DoD $26 million to support its share of the idle equipment in the industry, which is generally consistent with the previous equipment estimate.

In one approach, industry was requested to provide information on the budgetary costs of a number of fixed or semifixed cost categories; these included:

- General and administrative
- Depreciation
- Taxes
- Insurance
- Fringe benefits
- Utilities and maintenance
- Security
- Sustaining engineering.

Industry was then asked to estimate how much might be budgeted in these categories if sales were cut by 50 percent. With these two points, a projection was then made of these expenses if sales were reduced to zero. As expected, the magnitude of these fixed costs relative to sales was inversely proportional both to the percentage of capacity the firms were operating at and the overall sales level of the firms. The sales-weighted average of the data received from 75 percent of the industry showed that fixed costs are currently about 10 percent of sales. Specific data points are omitted due to their proprietary nature. The fixed costs associated with 1975 DoD sales of $5.5 billion would have been about $550 million. With the industry operating at 40 percent of capacity, $330 million would

be the cost to DoD of the extra capacity, which includes both the employment cost and the budget cost of facilities.

Other Defense Department analyses have found that the level of fixed costs in the aircraft industry is currently in the 10- to 15-percent range. At 15 percent, the above $330 million estimate becomes $500 million, making the cost of extra capacity to DoD in the range of $300 to $500 million.

One argument that favors extra capacity in the industry is that such extra capacity enhances competitive pressures and thus provides a better and lower cost product to the Defense Department. To test whether or not there was any extra capacity over and above that required to assure an adequate level of competition, criteria were established in several categories of DoD aircraft. These criteria consisted of minimum numbers of companies required to provide acceptable levels of competition in these categories of DoD aircraft. The numbers were subjectively derived and represent minimums for each category in the judgments of the study group members. The selected categories and numbers are:

Large Cargo Aircraft and Bomber	- 3
Fighter/Attack	- 4
Helicopters	- 3.

From the roster of existing companies, selections were made to meet these competition requirements. Account was taken for additional competition requirements, such as for commercial and antisubmarine and electronic warfare aircraft. From the activity level of those companies not selected as essential for these categories, it was estimated that the fixed cost to DoD of these "extra" companies was approximately $250 million. These companies represent 24 percent of industry capacity; their withdrawal from the industry would raise current capacity utilization from 41 to 54 percent.

This consideration was also examined from another perspective. If it is considered that part of the cost of extra capacity is associated with

indirect costs in the form of more managerial, design, and engineering entities than are required to develop and produce efficiently the needed output, the costs of extra capacity are the costs of maintaining more independent facilities (or firms) than needed--each with a viable marketing, design, engineering and production capability.

An estimate was made of the cost to maintain eight specific product centers which appear to have diminished sales prospects after 1982. These eight are currently operating at the same percentage of capacity as the industry as a whole. Based on the data collected from those product centers when it was made available and other estimates when it was not, the fixed cost of maintaining these eight particular product centers is $310 million.

This estimate also can be used to obtain another estimate of the total DoD cost of extra capacity. The eight facilities referred to in the previous paragraph represent 21 percent of the capacity of the industry. Extrapolating from this suggests that 100 percent of the fixed cost of the industry is about $1,500 million. The DoD extra capacity share of this fixed cost, based on 47 percent of industry sales and an industry operating at 41 percent of capacity, is $410 million.

One element of cost of capacity relates to the extra cost burden of maintaining some military aircraft production at low rates in order to maintain a warm production base. Examination of four specific programs which appear to have uneconomical production rates shows that each of these programs is incrementally costing the DoD between $20 million to $150 million per year, depending on specific program size and other business in the firms. This calculation is based on the assumption that 15 percent of procurement cost is fixed overhead and 5 percent is for sustaining engineering effort. This hypothesis results in an average total annual cost of $150 million to $250 million to DoD for the four programs.

It is the consensus of the analysts supporting this study effort that a "best guess" range for the cost to DoD of extra capacity is currently $300 million to $500 million annually, based on the current level of demand. By using the midpoint of this estimate, $400 million, and adjusting it for

projected changes in demand and changes in the DoD fraction of demand, Table 6 shows the expected future costs to DoD. The right-hand column shows the cost of extra capacity if industry productivity continues to increase at its 12-year trend of 1.8 percent per year. This percentage may increase with greater application of more effective productivity enhancements such as computer-aided manufacturing.

TABLE 6

PROJECTED DoD EXTRA CAPACITY COSTS
(Relative to Prior "Peak")

Year	Extra Capacity (Millions of AMPR lb)	DoD Share (%)	Projected (Millions of 76 dollars)	1.8% Capacity Growth
1976	81	42	400	410
1977	86	41	410	430
1978	88	44	460	490
1979	83	47	460	500
1980	76	50	450	510
1981	65	42	320	380
1982	64	40	300	370
1983	51	46	280	370
1984	47	48	270	390
1985	57	41	280	390
1986	54	44	280	420
1987	57	41	270	410
1988	57	41	270	430
1989	57	41	270	440
1990	61	36	260	410

Assumptions:

(1) 1975 DoD share of surge capacity is valued at $400 million.
(2) DoD share of sales is assumed to be one-fifth greater than share of AMPR weight, reflecting R&D, higher cost per pound.
(3) DoD assumed to share cost of extra capacity in proportion to its share of total sales.

F. BENEFITS OF EXTRA CAPACITY

1. Surge Capability

At any level of capacity utilization less than the maximum, the industry can increase production from warm production lines under surge or mobilization conditions by adding employment up to three full shifts. These are both assumed to be simply acceleration of warm production lines without resort to new or reactivated plant and equipment. Surge is defined as a rapid production increase (perhaps of only selected military lines) for a crisis condition--not necessarily in a period of "declared national emergency." Mobilization is defined as an all-out, three shift operation in a period of "declared national emergency," so that civil lines are diverted to military needs.

The peak recent production experience, during 1968, was achieved by the aircraft industry without exceptionally high manning levels. Except for the helicopter segment, the industry worked at about half the maximum possible output. Currently, the industry has essentially the same physical capacity as it had during Vietnam; therefore, a surge capability to double production beyond demand projections still exists. The capability to surge to a mobilization output of four times the present output exists by increasing employment, providing certain production constraints are eliminated. The constraints presented below were identified by both the Services and industry as being common to many aircraft programs; individual programs may have additional unique choke points. If extra capacity were eliminated entirely, the capability exists to surge to more than double current output, again by increasing employment.

Surge Production Constraints

- Engines
- Radars
- Landing gear
- Some numerical control equipment (5-axis profilers, etc.), which is now almost fully loaded
- Some fabrication shop work
- Shortage of tooling engineers
- Large forging capability.

Figures 6, 7, and 8 show the impact upon three types of aircraft inventory of attrition losses coupled with increased surge production. Both attrition and production estimates contain major uncertainties. For example, attrition projections are highly dependent on intensity of conflict and on the tactics, capability, and resolve of the participants. There are major uncertainties in all these aspects. In addition, the production estimates assume that all aircraft lines can be expanded simultaneously and that there will be sufficient resources to permit this. These estimates were generated assuming one-year warning and maximum production from existing warm aircraft lines. New lines were not added and old lines were not restarted.

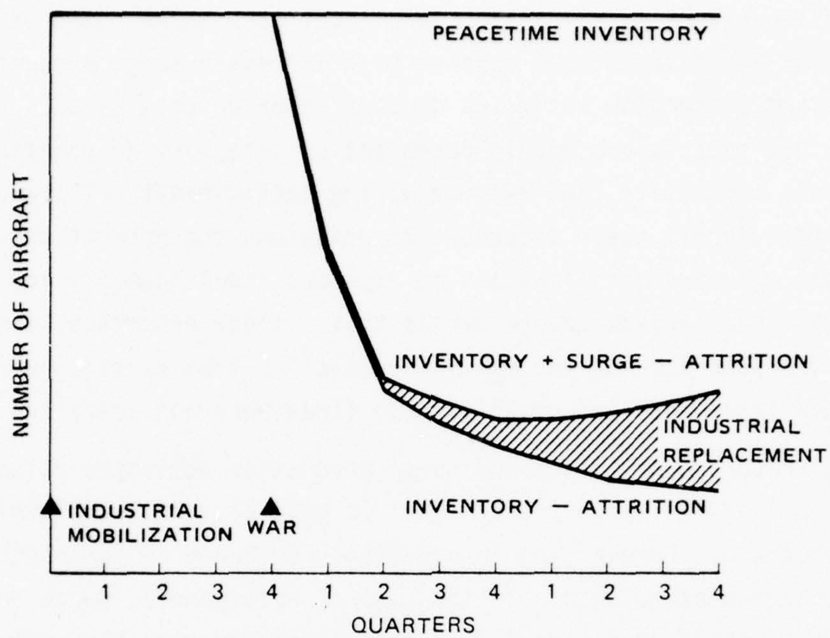
Comparing attrition and surge production estimates raises a question about the utility of surge production. In general, defense planning is based upon the U.S. prevailing in any likely scenario by means other than outproducing the other side. In the case of helicopters, surge production could have a significant effect in compensating for attrition within 12 to 18 months. In the case of mobilizing current warm airplane production lines, the resulting contribution to military capability would not be a factor until 18 to 24 months after the start of the surge.

Notwithstanding the limited ability of surge production to influence the outcome of a worst case conflict, a surge capability has been significant in the conduct of a limited conflict such as Vietnam and Korea. It is also beneficial for the reconstitution of inventory levels drawn down by transfers such as the transfer of F-4s to Israel in 1973.

2. Competitive Benefits

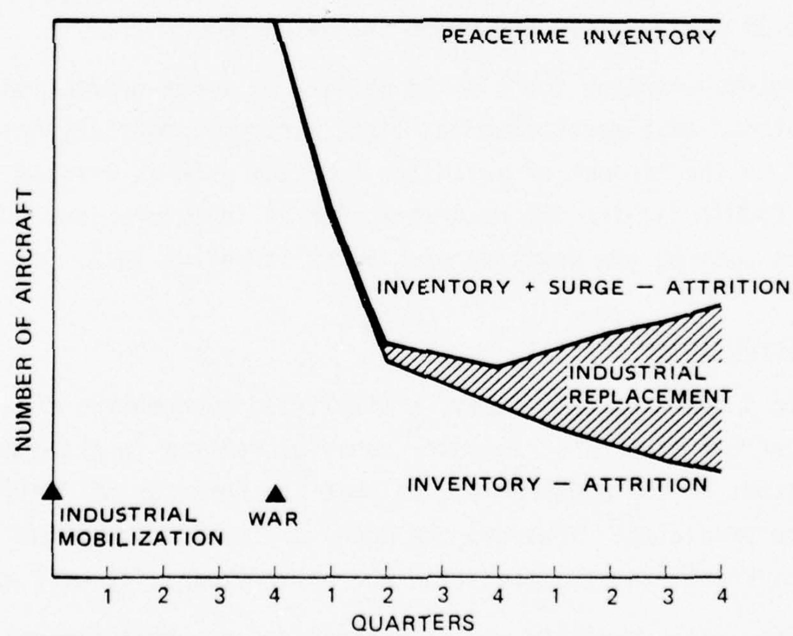
In support of this study, a simplified econometric model was developed in an effort to predict industry behavior related to extra capacity. The limitations of the model were such that the behavior of individual firms could not be predicted. However, the model did confirm that the industry will tend to stabilize at a condition where extra capacity will exist.

Simulation modeling and experience suggest that the existence of competition requires that extra capacity exist in a market characterized



NOTE: Mobilization of warm lines only

FIGURE 6. SERVICE "A" COMBAT ATTRITION VS SURGE PRODUCTION



NOTE: Mobilization of warm lines only

FIGURE 7. SERVICE "B" COMBAT ATTRITION VS SURGE PRODUCTION

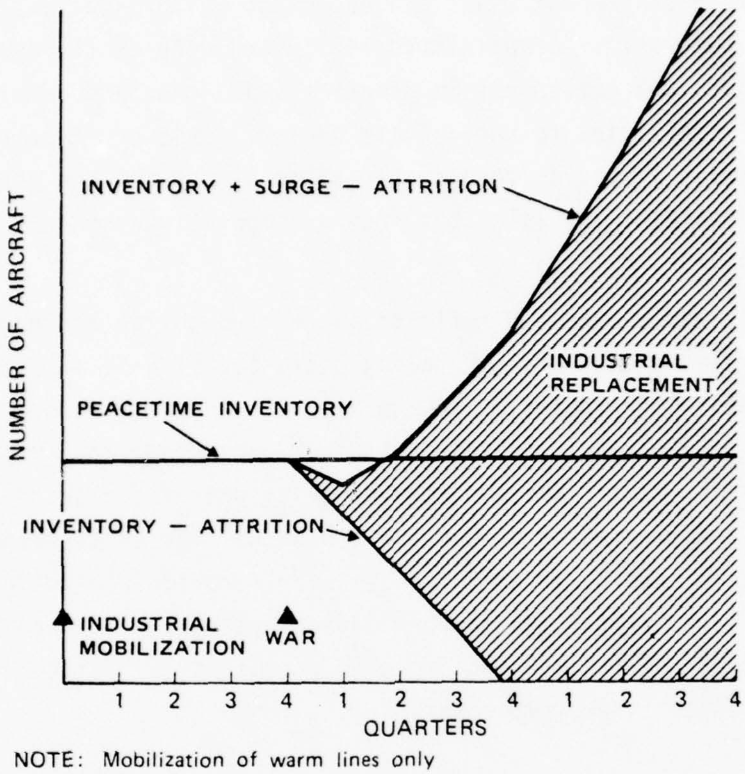


FIGURE 8. HELICOPTER COMBAT ATTRITION VS SURGE PRODUCTION

by cost based pricing. While the presence of capacity cannot assure a firm of success in competition, the absence of capacity, in particular the manpower capacity to generate viable proposals, will result in the firm being less successful in competition. The first imperative of the firm is to stay in business. Department of Defense practice to include bid and proposal expenditures as allowable costs encourages firms to stay in the defense market, since this practice allows the successful firm to recover some of the costs of this capacity.

Department of Defense policy, as established by the Defense Industrial Reserve Act of 1973 (Public Law 93-155), is to rely primarily

on the private sector for plant and equipment which in effect discourages government ownership. Despite this policy and efforts to divert itself of facilities, the government in practice still owns and provides substantial use of facilities to the private sector. This practice encourages firms to remain in the defense sector since it reduces the cost to the firm of maintaining the idle, but from a competitive point of view desirable, capability.

If extra capacity reflects associated design and engineering resources, then one benefit of having extra capacity is a larger technological base. The benefits to the aircraft industry of competition and technological superiority that result from extra capacity are substantial but not easily quantifiable. Extra capacity provides flexibility in plant layout and in alleviating production problems. The existence of multiple firms, at least two or three in each sector, provides competition during the R&D phase. Competition fosters better system performance in meeting the mission as well as new and improved operation and maintenance features which may reduce life cycle costs.

G. GENERAL AVIATION

Figure 9 shows demand and capacity for general aviation. Although demand has been volatile, the underlying trend is one of modest growth. Based on past responses to increased demand, general aviation is likely to opt for a continued increase in the capacity of its sector rather than use the extra capacity in the military and other commercial sectors.

The general aviation projection assumed that demand will grow proportional to GNP at about 3.2 percent per year. This would result in a 37-percent increase over 10 years, which compares with the 44-percent increase experienced over the past 10 years.

Figure 10 shows the impact upon industry capacity utilization if the projected demand for general aviation aircraft materializes and causes an expansion of the capacity of the general aviation sector, as is likely.

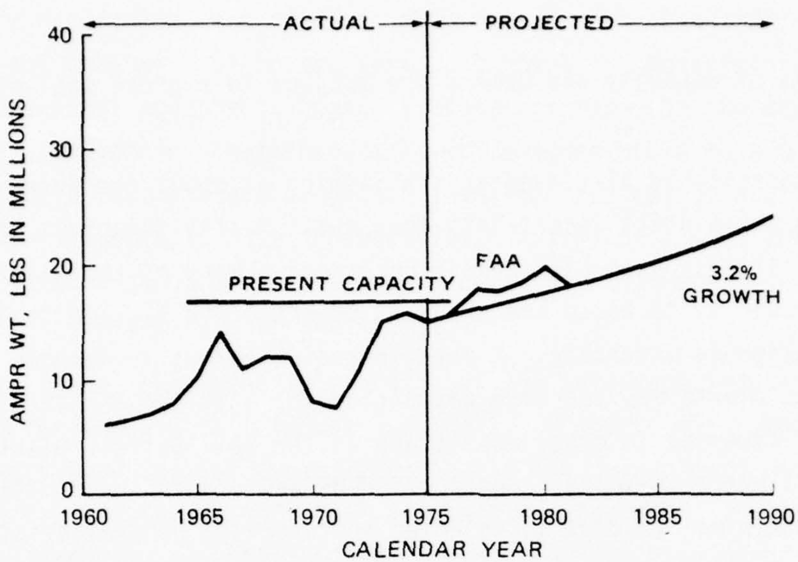


FIGURE 9. DEMAND – GENERAL AVIATION

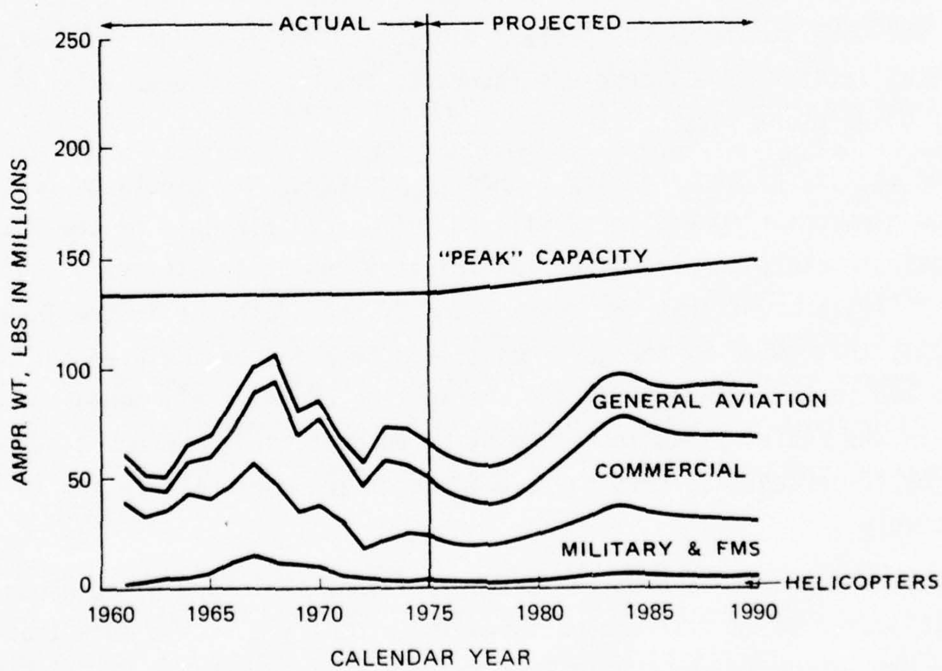


FIGURE 10. CAPACITY UTILIZATION – U.S. AIRCRAFT AND GENERAL AVIATION INDUSTRIES, 1961-1990

H. UNCERTAINTIES

Projections of capacity and demand are subject to a great deal of uncertainty.

Although capacity is displayed as stabilizing at about the current level, there is substantial uncertainty that the industry structure on which this capacity is based will remain unchanged. Many of the plants on which this capacity is based are products of World War II, and their continued retention is uncertain. A more intensive effort to dispose of government-owned plants may see some dismantled (as with the Martin Middle River plant) or diverted to other uses (such as the Bell Buffalo plant). With substantial extra capacity, construction of new plants and facilities is likely to be minimal (except in selected sectors like general aviation) unless allowed by the government and the costs reimbursed. Increased productivity gains are generally related to labor and not plant floor space. In fact, many of the advanced manufacturing processes for aircraft require more plant space per unit of output. This factor plus imposition of current OSHA standards may prevent employee plant loadings from reaching historical levels and may preclude increased output above peak experience for any given plant size.

The ability of the industry either to construct new plants or purchase advanced manufacturing equipment will be influenced strongly by the future financial structure and trends of the industry, which is also very uncertain. There is little doubt that the average age of the equipment in the industry, especially that owned by the government, has been increasing over the past five to ten years. Since 1965, the average age of privately owned production assets in the industry has increased by 50 percent, and government-owned assets by 40 percent, so that the average ages are currently 15 and 19 years, respectively.

Symptomatic of this problem is the fact that the share of aerospace sales allocated to capital expenditures is currently a little more than two percent, which is about half that for the durable goods sector, though

there is a recent upward trend in this number. Whether this phenomenon is due to the greater risk in the aerospace industry, government furnishment of some capital equipment, higher subcontract rates in the aerospace industry (suggesting that investment/value-added would be a more useful measure of investment adequacy than investment/sales) or whether the aerospace industry is just innately less capital-intensive than the rest of the durable goods sector, was an uncertainty that could not be resolved during the limited time of the study.

The lower investment/sales ratio of the aerospace industry was found to hold for the aircraft industry as well. However, this condition disappears when capital expenditure levels are compared to net income or working capital, suggesting that aircraft manufacturing is simply not as capital-intensive as other high-technology, non-defense manufacturing industries. It also was found that while the debt burden of the aircraft companies has increased significantly from 1967 to the present, this growth was virtually the same for the aircraft manufacturers as it was for other high-technology manufacturing firms. The same comparative behavior was also found to be true for debt/equity ratios. However, the commercial firms are borrowing against future profits in a rising market, while the future market of the aircraft industry does not look as bright. Further study of debt, the equipment aging problem, etc., is clearly needed.

Demand for commercial transports is particularly sensitive to such issues as the state of the economy, whether new financing mechanisms can be developed to enable the airlines to afford to rebuild their fleets more rapidly, whether more restricted energy and noise standards will be introduced, and when the near-term trough will end and a major replacement cycle will begin.

Historically, the demand for military aircraft has been subject to wide and large unpredictable variations as military technology and strategy change and as national priorities adjust to changes in international tensions. For at least the past 40 years, there has been

sufficient turbulence in international affairs to have made aircraft demand projections beyond five years invalid. The current Five-Year Defense Plan (FYDP) and Extended Planning Annex (EPA) project aircraft procurements at about two-thirds that level required to maintain the current inventory at the current fleet age. Uncertainty regarding out-year budgets and the costs of new aircraft programs casts uncertainty on the use of FYDP and EPA projections in estimating industry demand. In addition, there is uncertainty over both the timing and magnitude of the procurement of cargo and bomber aircraft, a major component of DoD procurement in the decade ahead.

Another major uncertainty in the demand for military aircraft is the future level of sales of military aircraft to foreign governments. While in past years such uncertainty would be of little concern because of the low level of foreign sales relative to DoD sales, in the future this uncertainty will be far more important because of the large share of U.S. military aircraft production allocated to foreign users. The impact of foreign sales on the size and distribution of U.S. military aircraft production can be seen by comparing Figures 4 (page 19) and 11. In Figure 4, the past and projected production of DoD military aircraft are shown, while Figure 11 shows all military aircraft production past and projected including foreign sales. The ratio of foreign military to U.S. military AMPR weight production is seen in Figure 12. Particularly at the present time the impact of foreign sales is substantial, especially in the fighter/attack category. Indeed, about half the fighter-attack aircraft built in 1975 were for export. While constant foreign sales for the 1979-1990 time period were assumed (increasing DoD procurement in the late 1970s and 1980s accounts for the drop in the ratio), substantial deviations in either direction are very possible, with important consequences for the industry as a whole and possibly crucial consequences for individual firms.

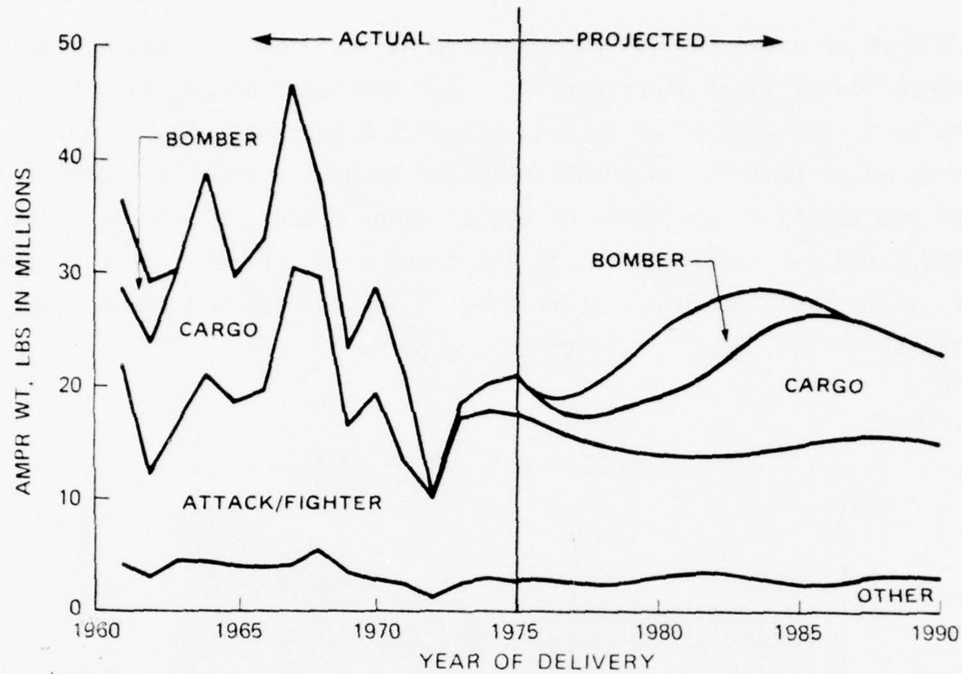


FIGURE 11. TOTAL PRODUCTION OF MILITARY FIXED-WING AIRCRAFT FOR U.S. AND FOREIGN SALES, 1961 – 1990

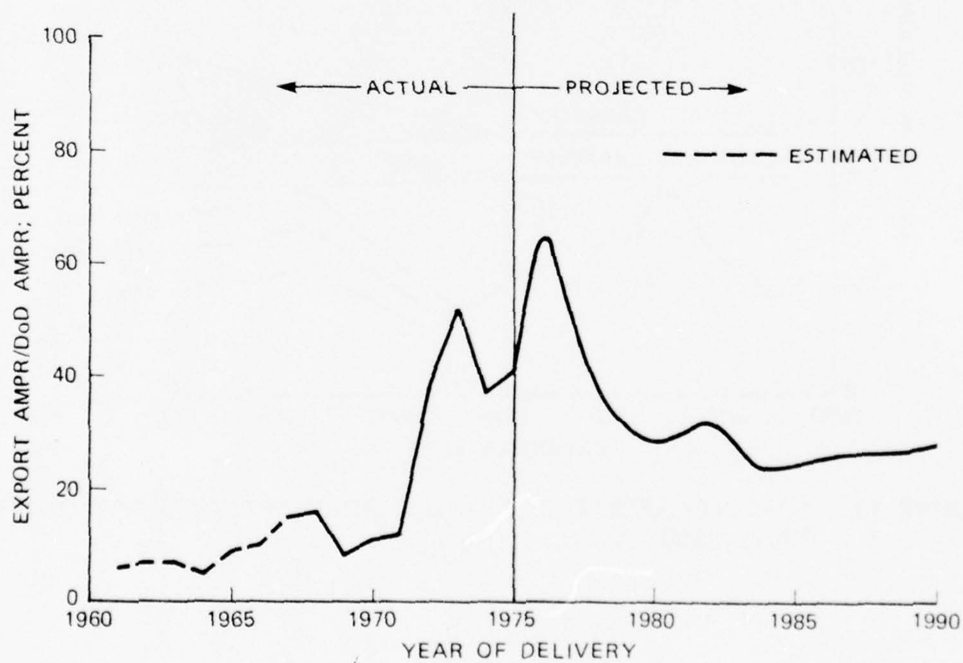


FIGURE 12. RATIO OF MILITARY AIRCRAFT PRODUCTION: FOREIGN SALES TO U.S. SALES

Figure 13 shows the estimated extent of variation in capacity and demand caused by these uncertainties. For the upper bound, capacity is projected to increase at an annual rate of 1.8 percent. The lower bound reflects adjustment for more sophisticated machinery and the imposition of health and safety restrictions on use of floor space. Military, commercial transport and helicopter demand is increased by 25 percent for the upper bound, while baseline demand is reduced 25 percent for the lower bound. General aviation is excluded from this figure.

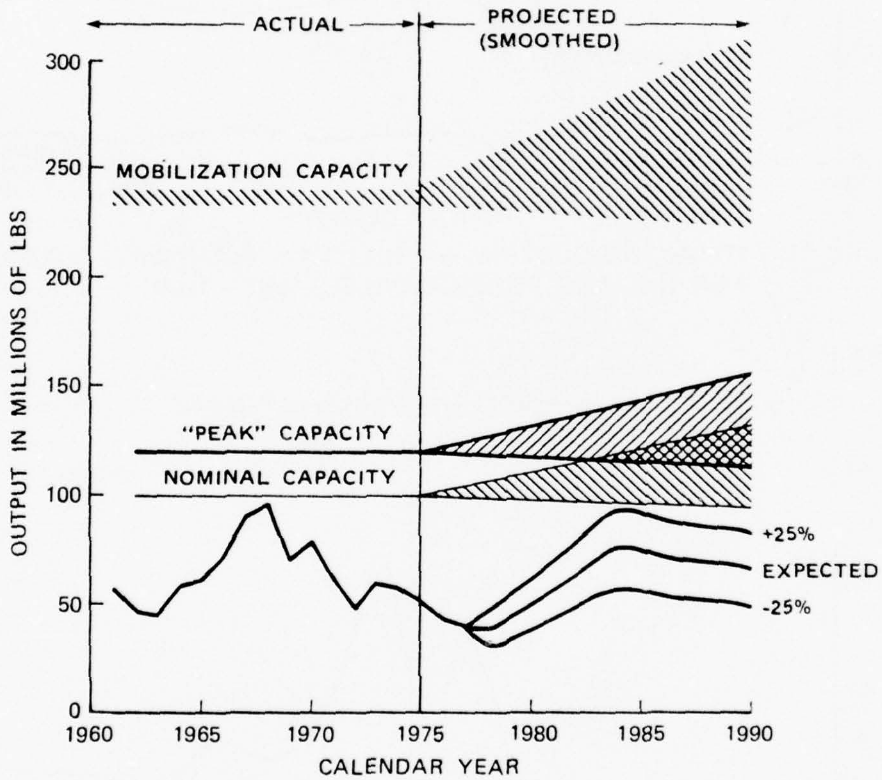


FIGURE 13. CAPACITY UTILIZATION – U.S. AIRCRAFT INDUSTRY OUTPUT, 1961 – 1990

As a final thought on the matter of uncertainty, it is well to note past experience in making projections. A 1971 interagency study's projection on the commercial aircraft market used wide brackets in bounding its estimate, yet the 1976 experience, only five years later, came in on the extreme lower bound of that estimate. In addition, the past vagaries of military aircraft procurements, as seen in Figure 14, offer scant hope that such an unpredictable past suddenly will transform into the tame and steady future portrayed in the figure.

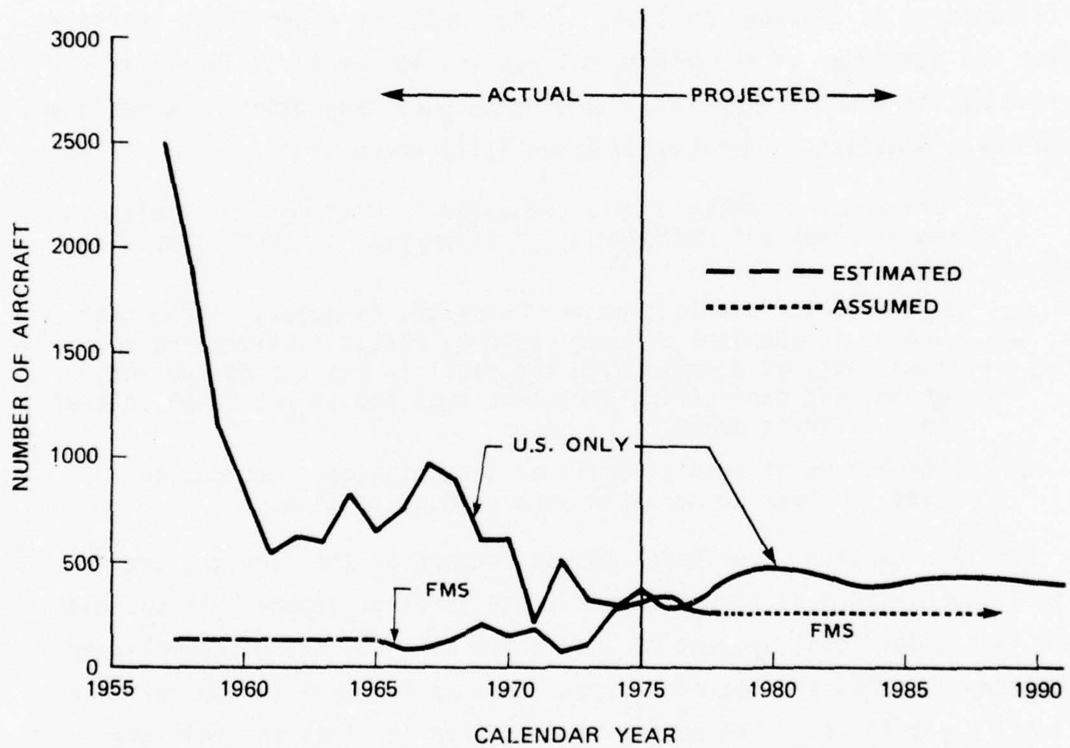


FIGURE 14. TACTICAL AIRPLANE PROCUREMENT TRENDS

III. ASSESSMENT OF POLICY ALTERNATIVES

A. POLICY ALTERNATIVES

There are a variety of positions the Department of Defense might take toward extra capacity in the aircraft industry. These range from maintaining the status quo to increasingly active government involvement in determining the structure of the aircraft industry.

Chapters I and II identified extra capacity in the industry of over 50 percent and estimated that the associated annual cost to DoD of this extra capacity is $300-500 million. These costs are expected to increase during the remainder of the 1970s, but decline in the early 1980s, if the current military procurement plans and commercial projections are realized. These costs manifest themselves in essentially three ways:

- More total capacity than is required to meet demand results in low facility and manpower utilization with inherent cost implications.
- More separate plants than are required, especially those that support independent product centers, result in fixed and semi-fixed costs associated with the facility and its management, design, and engineering structure that add to the total cost of the industry's products.
- Procurement of some aircraft at low, high cost production rates in order to maintain warm production lines.

For this Chapter, four basic market sectors of the industry are defined, each with a different capacity and level of demand. In addition, there is a significant segment of industrial activity being accomplished in government owned and operated depots that is relevant to any review of national capabilities. The market sectors used for this analysis are:

- Large commercial aircraft, defense transports and bombers
- Fighter/attack and specialized aircraft
- Helicopters
- General aviation aircraft.

This Chapter identifies eight policy alternatives that have been considered to reduce the burden of the extra industry capacity. The characteristics and major defense programs of the four sectors are described as are the pros and cons of each alternative as they apply to the industry sectors. Future annual savings associated with each alternative five years hence are estimated, and judgments of the feasibility of implementing each of them are presented. Finally, a number of immediate, near-term, programmatic, and long-term considerations are identified for possible implementation.

The eight policy alternatives presented here were selected as the most promising alternatives from a much larger list of actions that DoD could take to influence capacity in the industry. Not all alternatives are mutually exclusive. In fact, the best approach is likely to be a combination of alternatives with some variation in application to the various sectors. The alternatives are arranged in gradations of increasingly active government involvement.

These are:

Alternative 1. Continue current aircraft procurement practices with evolutionary improvements.

Alternative 2. Allow more free market operation with the intent of reducing extra aircraft capacity.

Alternative 3. Establish acquisition procedures which encourage consolidation and contraction of the industry.

Alternative 4. Mandate a rigorous policy of procuring aircraft at efficient production rates through DSARC or other decision processes; buy out or terminate low rate production.

Alternative 5. Deliberately phase military aircraft development and procurement to avoid large industry buildups and drawdowns allowing free market operation to size the industry.

Alternative 6. Augment demand of the private sector of the aircraft industry by shifting activity from military depots to private industry.

Alternative 7. Reduce active extra capacity of industry by mothballing or closing several government-owned plants or product centers.

Alternative 8. Achieve modernization and work force stabilization of selected facilities.

B. SECTOR CHARACTERISTICS

To gain more insight as to how these alternatives might apply to a particular sector, the current and future defense programs are summarized by company in each sector as well as the present general characteristics of that sector.

Large Commercial Aircraft, Defense Transports and Bombers:

Company	Defense Programs
Boeing: Washington and Kansas	E-3, E-4, ATCA,[a] AMST[a]
Lockheed: California and Georgia	P-3, S-3, C-130, C-5 Mod, C-141 Mod
McDonnell-Douglas: California and Missouri	C-9, ATCA,[a] AMST[a]
Rockwell: California and Ohio	B-1

[a]Source selection not yet determined.

Characteristics:

Most of the business of these firms is commercial with defense business at low levels (except Rockwell, with the B-1 in production). Each company has two main, geographically separate aircraft facilities (Rockwell operates a government-owned plant at Columbus, Ohio). Commercial sales demand is moderate in the short term (3-5 years) but a resurgence is expected in the 1980s. These firms could do depot maintenance on airframes. All companies have an inherent surge capability since virtually all commercial production could be made available for military use in a major crisis.

Fighter/Attack and Specialized Aircraft:

Company	Defense Programs
Fairchild: New York and Maryland	A-10
General Dynamics: Texas	F-16
Grumman: New York	F-14, E-2, A-6, EA-6
McDonnell-Douglas: Missouri and California	F-15, F-18, AV-8, A-4
Northrop: California	F-5, F-18 (major subcontractor)
Rockwell: Ohio	OV-10, FV-12
Vought: Texas	A-7

Characteristics:

These firms have moderate to high activity levels with the exception of Rockwell and Vought. Considerable activity level is generated through foreign military sales. There is limited long term growth, short of a major military emergency, for all but two or three firms. These companies have an inherent large surge capacity provided certain bottlenecks are alleviated. The future viability of some companies as prime contractors is uncertain. Subcontract work is necessary by some companies to stay in business.

Helicopters:

Company	Defense Programs
Bell: Texas	AH-1, UH-1
Hughes: California	AAH
Kaman: Connecticut	None
Sikorsky: Connecticut	CH-53, UTTAS, LAMPS III[a]
Vertol: Pennsylvania	CH-47, CH-47 Mod, LAMPS III[a]

[a]Source selection not yet determined.

Characteristics:

These firms currently have high activity levels in research and development, subcontracting and in the maintenance areas with the exception of Vertol and Kaman. Defense production activity is low, while commercial and foreign military sales activity is moderate. A large surge capacity presently exists. There is substantial industrial helicopter activity in the service depots.

General Aviation:

Company	Defense Programs
Beech: Kansas	C-12, drones
Cessna: Kansas	Utility aircraft, A-37
Piper: Pennsylvania, Florida	No defense contracts at present

Characteristics:

Commercial activity levels relative to capacity are currently high and growing. There are very few large dollar defense sales either as a prime or subcontractor. Almost all work is done in the firms' own facilities (low subcontract rate). They have a substantial surge capability as well as a substantial capability to accept subcontract work on military aircraft components from other firms.

C. POLICY ALTERNATIVE ASSESSMENT

Alternative 1--Continue current aircraft procurement practices with evolutionary improvements.

Application

This alternative could apply to all sectors.

Discussion

The baseline case is to maintain weapons acquisition, procurement, and other relevant policies essentially as is.

Current aircraft procurement methods sustain a competitive industry that has been efficient compared to European firms. This has been demonstrated by the success of U.S. industry in the competitive international market. Currently, about 72 percent of the world commercial fleet (except the U.S.S.R.) is of U.S. manufacture, though the European A-300-B Airbus sales and U.S./foreign consortium activity may well balance this over time. Foreign military sales of fighter/attack aircraft and helicopters have been dominated by U.S. firms. In the aircraft industry, price competition is often less important than technical competition, i.e., the capability of a firm to conceive, design and develop a superior product to exacting specifications.

Arguments - Pro

This alternative requires no new implementation. It is favored by those who believe that substantial savings from reduction of extra capacity would be difficult to achieve. In the commercial area, the existing firms provide a firm technological base and ensure adequate competition and a mobilization production base. An annual cost of extra capacity to DoD is acknowledged, but this alternative accepts this cost as reasonable for the benefits received or as difficult to avoid.

Arguments - Con

The most important argument against a status quo policy is that extra capacity is costing the DoD $300-500 million annually. Furthermore, this figure is likely to grow in the near term until it is reduced by the expected long term growth in demand in the commercial sector.

Alternative 2--Allow more free market operation with the intent of reducing extra aircraft capacity.

Application

This alternative could apply to all sectors.

Discussion

The dominance of the DoD as a customer, government ownership of a significant portion of the industry's facilities (approximately one-third of the floor space), progress payments, guaranteed loans, and government funding

of most research and development preclude the functioning of pure economic forces. Although several aircraft product centers disappeared between 1960 and 1968 through consolidations or failures to generate business, there have been no significant consolidations since then despite an average reduction in demand of some 40 percent over this period. Emerging consortium agreements may become another form of consolidation.

This alternative would attempt to reduce the extra capacity of the industry by methods ranging from government persuasion to changes in acquisition policies. DoD spokesmen could emphasize that DoD procurement planning projections show that: (1) there is no substantial increase in defense aircraft business; (2) there is a reduction in the number of different types of aircraft to be purchased; (3) there are more suppliers available than potential new systems; and (4) further business for some military-oriented firms must be found elsewhere, in the commercial sector or through increased subcontracting. A firm government policy against any subsidization or loan guarantees could be made and enforced. Some sustaining costs, such as proposal preparation, might be made non-reimbursable.

Arguments - Pro

Changes are more likely to occur if the industry believes DoD does not desire to maintain the present industry structure. Making the business environment more competitive and less protective would tend to reduce the number of firms. If profit margins were increased to compensate for the greater difficulty in doing business, the fewer residual firms might emerge healthy with capital to invest in modernization which could further reduce costs. Legal impediments to this course of action are minimal since it involves no pre-selection of winners.

Arguments - Con

The basic argument against a persuasion policy is that businessmen put more weight on actions than words. It runs counter to recent trends in government procurement policy since it suggests exclusion of costs which have become allowable only recently.

Alternative 3--Establish acquisition procedures which encourage consolidation and contraction of the industry.

Application

This alternative could apply to all sectors except General Aviation.

Discussion

Despite present high levels of extra capacity and no immediate apparent increase in defense demand, firms tend to invest to increase capacity and to maintain present capacity. Steps might be taken to erect barriers to new capacity creation and to shift the costs of carrying extra capacity from DoD to the firms. Changes in the Armed Services Procurement Regulations (ASPR) might prove effective in providing barriers to entry of firms with a small business base or doing only subcontract work. The basing of profit awards on investment is now being emphasized. More stringent measures of overhead reduction might be imposed. Allowable overhead costs might exclude certain extra capacity costs. Increased product or bidder qualification requirements could be implemented, and emphasis could be placed by source selection boards on favoring those bidders with a large business base. DoD could reject proposals to fund new facility construction and require the use of existing facilities.

Arguments - Pro

The pro arguments are basically those of Alternative 2. This alternative, however, recognizes positive action may be necessary to prevent continuation and increases in costs to DoD of extra capacity. Implementation using the ASPR appears feasible.

Arguments - Con

This alternative would represent a departure from recent Defense procurement policies and would be criticized as jeopardizing a strong industry segment essential to national strength. Changes to existing regulations can be bogged down and weakened in the lengthy process of coordination and implementation.

Alternative 4--Mandate a vigorous policy of procuring aircraft at efficient production rates through DSARC or other decision processes; buy out or terminate low rate production.

Application

This alternative applies primarily to the Fighter/Attack and Helicopter sectors.

Discussion

The current practice is to program aircraft production rates considering many factors. These factors include urgency of need, budget constraints, relative priorities, plant capacity, and program cost. Since these different considerations often are countervailing and change throughout a program's life, actual production rates often vary substantially from initially planned rates. Since World War II, only the C-141A has been procured at the rate and in the quantity initially planned. The variations have caused inefficiency in the production process that has increased the unit cost of military acquisitions.

The process of determining the minimum program cost production rate is not rigorous but has been amenable to reasonable analysis. Most program managers develop a theoretical rate initially and then develop their programmed rate at a lower level based on budget constraints. Once the production tooling is accomplished for a given rate, increased rates usually result in additional nonrecurring costs which tend to cancel any savings that might have resulted from the higher rate. Lower rates underutilize tooling and facilities, but the costs of these assets are usually sunk and do not increase unit budgetary costs. Sometimes, drastic reductions in rates involve reconfiguring assembly lines and thus incur a nonrecurring cost. Aircraft production experience indicates that essentially normal learning curve experience on the assembly line still occurs when production rates decline. Higher costs of low rate production are manifested primarily through higher nonrecurring costs and increased overhead rates.

Aircraft that have experienced significant periods of low rate production include the A-4 series, RA-5, E-2 series, A-6 series, EA-6 series,

and A-7 series. These low rates have been rationalized generally by near-year fiscal constraints and a need to maintain a warm production base for repair, spares and attrition losses. Some (A-4 and A-7) of these aircraft programs have generated substantial foreign sales during their period of low production rates for U.S. forces.

Potential savings from procuring at more efficient production rates are dependent upon the specific programs that are proposed to be bought out at faster rates or cut off. A recent decision pertaining to acceleration of the F-14A rate avoided a unit cost increase of about 50 percent (or about $10 million per aircraft) by one estimate.

Arguments - Pro

The principal supporting argument is that this alternative would reduce total systems costs. There could be savings in indirect and overhead costs which in turn would permit faster force modernization and higher total procurement quantities within the same level of resources. It might precipitate reductions in extra capacity at the cost of contractor failures.

Arguments - Con

Production rate currently receives consideration in the decision process, and this factor must be balanced with other valid considerations. The value of a warm production base for spares, repairs and attrition losses, the benefits of aircraft series improvements versus new procurements to fulfill mission needs and increased foreign military sales favor extended production even at low rates. Because of budgetary constraints and the existence of requirements for specialized low production rate aircraft, this policy would be difficult to enforce. In some cases, a near term (FY 78 and FY 79) increase in the budget would be necessary to buy out several years of remaining production.

Alternative 5--Deliberately phase military aircraft development and procurement to avoid large industry buildups and drawdowns allowing free market operation to size the industry.

Application

This alternative could apply to all sectors except General Aviation.

Discussion

This alternative would phase military (including FMS) and commercial aircraft development and procurement in a manner that would minimize turbulent industry buildups and drawdowns and maintenance of unneeded extra capacity. Explicit introduction of industry stabilization into DoD programming would be a major change in policy if carried to its full potential. In effect, this alternative would attempt to couple business stability with a reduction in industry capacity and costs. Some decision would have to be made in regard to "required" capacity which would have to be taken into account in phase planning.

The aircraft industry historically has experienced cyclical boom or bust activity levels and high workforce turbulence. During the past 15 years, aircraft industry employment nationwide has experienced both an expansion and contraction that has twice resulted in employment levels changing by a factor of two. At the firm level, even greater turbulence has occurred, resulting in substantially greater changes in employment levels. This personnel turbulence generates costs associated with recruiting, training and terminating workers.

If aircraft developments and/or procurements could be phased, extra capacity could be reduced. Costs and inefficiencies associated with personnel turbulence could also be reduced. The result could be the acquisition of military aircraft at lower overall costs. During peacetime, the government can consider phasing military aircraft developments and/or procurements by sector, with the principal objective being to maintain a competitive base.

Phasing production with foreign military sales and U.S. military procurements provides a special opportunity to stabilize plant workloads since FMS lead times are comparable to U.S. budget lead times.

Some plants share civil and military production activities. In these instances, phasing of military procurements could be controlled to balance commercial work variations that result in unstable plant loading. This initiative could be especially remunerative when variants of the same aircraft are being produced for both commercial and military use. The present E-4 and C-12 aircraft procurement programs are examples of military/civil phasing. Similar phasing is being considered in the future in the ATCA program.

The Interservice Helicopter Commonality Study determined that the present spectrum of DoD helicopters contains models with overlapping performance capabilities, but possesses sufficiently different airframes and related components to require different training and logistical support and requires separate development programs. The study concluded it is feasible to meet all the Services' helicopter requirements with a family of five baseline helicopters and three variant helicopters. The present DoD inventory consists of nine baseline and six variant helicopters. A policy memorandum with the goal of achieving greater helicopter commonality with fewer baseline models and variants has been approved recently. The specific implementation would be to assure that the LAMPS and ASH helicopters are based upon existing airframes and not new, low rate, high cost airframes. A similar policy for fighter/attack and other aircraft types might be warranted.

Arguments - Pro

This alternative probably would reduce the cost of military aircraft acquisitions. Phasing both development and procurement would improve the working environment for the firms in the industry. It should generate improved stability and earnings which, in turn, would encourage capital investment in modern equipment. In addition to these savings, start-up costs and costs associated with uneconomically low production rates might be avoided. Improving the ability of firms to project business expectations

should encourage the orderly departure of firms with unsatisfactory projections. Capacity could be related better to requirements which would permit procurement of longer runs of fewer different types of aircraft. From a budget point of view, net savings might result from reduced extra capacity. Employment would tend to be stabilized, thereby avoiding the economic and social costs of turbulence in the industry.

Arguments - Con

The basic objection to this alternative is that, if carried to extremes, it might require designation of a set of favored suppliers whose business base problems would be the subject of explicit attention. A more or less guaranteed business base could lead to inefficiency and lack of business rivalry that could increase costs. This alternative favors those firms at a cycle peak when the policy is adapted. There is a possible unfavorable impact on force modernization caused by phasing delays which may not be adequately offset by the advantages of fewer new types of aircraft being introduced simultaneously in a sector. Practically, this proposal assumes that a reasonably accurate forecast can be made of military needs and commercial demands over a long period of time and that procurements would not have to be adjusted significantly in the short run. For the military, it also implies that force modernization schedules and budget totals would be adjusted to maintain stability. Long term plans often have to be stretched and smoothed due to budget exigencies, policy changes, or political events. This proposal would require that such smoothing, to the degree possible, be an integral part of the initial plan.

On the commercial side, demand is very difficult to forecast and lead times to make changes may be so long as to be unrealistic. DoD might have to sacrifice timing of requirements to the commercial market demand.

Alternative 6--Augment demand on the private sector of the aircraft industry by shifting activity from military depots to private industry.

Application

This alternative could apply to all sectors.

Discussion

This policy alternative would reduce the cost of extra capacity by reducing total national capacity but would focus this reduction on industrial installations owned and operated by the military services. This focus is suggested as being consistent with the national policy that the government will rely primarily on the private enterprise system for goods and services.

The military services currently operate 13 depots performing industrial type activities on military aircraft (excluding engines). These installations currently are operating at an activity level of about 25,000 employees and a budget level of about $1.3 billion. These government installations duplicate some capabilities of private industry.

The basic national policy of reliance on private industry is stated in OMB Circular A-76 and amplified in more recent Federal procurement policy regulations and departmental instructions. Exceptions to this basic policy are authorized for the maintenance of mission essential combat readiness or when there are clear economic advantages. What constitutes mission essential activity is not well defined, however.

There has been wide variation in implementation of the division of activity between in-house and contracted activity. There is a consistent trend to maintain relatively level activity in-house. With total efforts declining, the result is a significant trend to a greater percentage of the total effort in-house in all Services.

Keeping industrial activity in-house has been justified by several arguments. These include responsiveness to Service needs, training for military maintenance personnel (except Air Force), mobilization potential, government expertise on aircraft systems, and independent cost validation of commercial industrial activities. Perhaps the most compelling is the capability to accommodate a surge maintenance capability in the event of mobilization.

It is not clear, however, that organic depot facilities can accommodate increased demand more rapidly than private industry. For example, the 1965-68 Air Force workload surge was carried initially by industry and not accommodated by the depots until 1970. The GAO criticized the Army for procuring new UH-1 helicopters from Bell when several hundred were awaiting repair at Army depots. It was argued that Bell could have accomplished the repair, and the Army could have avoided the procurement.

There is a rational argument that the prime aircraft contractors maintain fully structured industry product centers that have higher overhead costs than a more focused depot. Thus, depot costs for a given function are less. Industry responds that the fully structured companies are required and are supported already and that it is needless to support the fixed cost of so many military industrial installations that are not required. The industry also argues that some private companies are narrowly structured specifically to accomplish modification and overhaul work and do so at relatively low costs. Shift of this work to these firms, however, would not help carry the overhead burden of extra capacity that manifests itself in too many fully structured product centers.

The budget process is such that depots are supported fiscally from many funding pools, including unfunded retirement obligations that are incurred. The result is that the "out of pocket" cost to program managers is less when work is performed by depots even if the real costs to the U.S. may be comparable or even higher. This budget situation results in institutional pressures to resist any significant shift in activity from military depots to private industry.

There is one estimate that indicates that if five aircraft depots (1 Army, 2 Navy, 2 Air Force) were closed, the in-house activity would be reduced by 20 percent and fixed costs on the order of $40-50 million annually would be avoided. If the effort were merely shifted from depots to private industry without closure of any depots, cost savings would not be likely.

Arguments - Pro

Basic government policy in OMB Circular A-76 calls for industrial-type activities to be performed by private firms unless the requirements of combat readiness or clear economic advantages dictate otherwise. Shifting this activity to the private sector would be in accordance with this policy. The second equally basic argument for the alternative is that it would contribute directly to improving capacity utilization in the private aircraft industry. Net employment might be reduced because the private sector does not need employees to maintain a rotational base for military training, etc.

Arguments - Con

Contract aircraft overhaul often is done by other than prime aircraft contractors. This option might result in increased overhaul activity overseas or growth of a new industry with little impact on those firms building aircraft.

In addition to the mobilization role, the depots provide training, resident technical expertise and a source of costing experience to the Services. In the last ten years, a substantial DoD investment has been made in modernizing the depots so that it might make sense to consider contractor operation of these, rather than outright closing. The Services have the responsibility to insure combat readiness by maintaining a capability that they can control. Realization of major cost savings would require base closing procedures with attendant political and social difficulties.

Alternative 7--Reduce active extra capacity of industry by mothballing or closing several government-owned plants or product centers.

Application

This alternative applies to all sectors except General Aviation.

Discussion

This alternative would envision a significant restructuring of the aircraft industry. The idea is to reduce extra capacity and cost to maintain that capacity by reducing the number of firms (each maintaining independent

managerial, design, engineering, and production capabilities) in excess of the number that could develop and produce the needed output at efficient rates of capacity utilization. From the standpoint of the individual firm in the airframe industry, demand is characterized by large peaks for individual production programs with a considerable degree of uncertainty as to when the next peak may occur. The large payoff associated with the peak, together with the relatively small costs to the firm in maintaining extra capacity, particularly in government-owned facilities, has resulted in the maintenance of more than the required number of design teams and production facilities.

On the other hand, the strength of the U.S. aircraft industry has evolved largely because of a large, competitive industry capable of developing innovative designs in each mission area. As aircraft systems tend to become more sophisticated and technically complex, the trend is to fewer competitive proposals in each mission area.

There was a reduction of about ten vertically capable product centers between 1960 and 1968 and approximately half that number since 1968. Some product centers are in a marginal status now, but have not disappeared through normal competitive forces. The trend toward fewer new types of aircraft is clear. The current structure is such that in some sectors it appears that a number of product centers are not essential to the maintenance of a viable, competitive industry.

Cost data show that the sustaining costs that a firm incurs to remain a competitive bidder are about 10 to 15 percent of recent sales. A detailed survey of selected plants has disclosed that the percentage is higher at low sales levels.

An analysis was conducted to establish the cost of maintaining different populations of product centers. This required some judgments regarding the need for various product centers. Cost savings from the exit of three selected product centers from the market have been estimated at $50 million annually, while the cost savings from the exit of eight selected product centers is about $250 million.

These cost savings would be generated only after a five-year implementation period and would require some early year funding to accomplish displacement of some capabilities.

Cost savings projected from consolidations contain a presumption that fixed and semifixed overhead costs of a consolidated activity will be less than that of two or more activities accomplishing essentially the same direct efforts. In this instance, projected savings are based on an assumption that the consolidation will result in fewer facilities, operating at higher utilization rates and, therefore, at lower overhead costs. Consolidations also involve nonrecurring costs. Such actions are similar to base closure efforts with savings being generated only over a period of time after closure.

A variation to closing is to retain the physical production facilities at a reduced cost by mothballing. Plants with low projected workloads, but which should be retained for surge requirements, may warrant mothballing. Mothballing one small and two medium-sized plants would cost approximately $10 million. Annual savings would be about $45 million compared to an annual savings of $50 million if the plants were closed.

Arguments - Pro

This study suggests that there are too many independent firms and corporate divisions. The departure from the defense market of one or two in the helicopter field, and two or three in the fighter/attack category, could be cost-beneficial. The resulting higher facility utilization would reduce overhead sustaining costs to both commercial customers and to DoD. The advantage of this alternative is reduced annual cost of maintaining more than the necessary number of independent facilities. After initial turbulence, employment would tend to stabilize in particular geographic areas. Consolidation should result in greater utilization of extra capacity. Mothballing would require small annual costs, but still maintain production facilities for a long, major conflict.

Arguments - Con

The difficult aspect in this alternative is achieving reduction to the number of facilities needed for each class of aircraft to provide competition and maintain U.S. technological supremacy. In addition, the only direct means for DoD to close a plant is by denying contractors the use of government-owned facilities and declaring them surplus. Generally, the existence of a firm's infrastructure is beyond DoD's direct control. Facilities costs, however, constitute a relatively small part of aircraft industry costs. Therefore, savings are tied to reductions in management, design and other support functions. Also, due to extensive co-ownership and commingling, some facilities are only tenuously subject to DoD control. As a result, it would be difficult for DoD to implement this policy and be confident of a high degree of success. This alternative favors facilities operating at high current business levels.

Alternative 8--Achieve modernization and work force stabilization of selected facilities.

Application

This alternative could apply to all sectors.

Discussion

This alternative would envision restructuring both the aircraft industry and the procedures by which the government acquires weapons. Restructuring has been much discussed within the analytical community; the alternative presented here would combine some of the common ideas about how industry structure might be modified with a proposal for implementing modern, advanced production technologies in the resulting organizations.

One concept is to restructure the aircraft industry so as to separate corporate development and production capabilities. (Other options include less separation.) This restructuring would provide multiple design teams in each major aircraft sector to insure innovative and competitive designs, but would schedule subsequent production in a smaller number of modern production facilities. Design teams would receive incentive awards for

successful designs. The government would procure rights and data to the design as a basis for subsequent production awards.

Modern plants could be more automated and partially controlled by computer programs. Unlike automated plants configured for a high rate commodity such as ammunition, these plants should have the capability to change product outputs from one aircraft to another by changing the computer program. Even where automation is not practical or economical (perhaps in final assembly), efficiencies of work force stability and learning curve effects would be achieved. Ownership options for the production facilities include private, semi-private on the COMSAT model, or government ownership with contractor operation (on the ERDA model)--or a mix of these as currently exists.

Arguments - Pro

This proposal would retain competition in research and development while, at the same time, reducing extra capacity through establishment of a limited number of highly productive government-owned, contractor-operated production facilities. By standardizing production capabilities, better comparisons could be made of competing aircraft designs. More development options would come about with only a few going into production and deployment. The current structure makes this difficult. Industrial stability and modernization would be enhanced, and greater tri-service standardization should be achieved. Implementation of this proposal may reduce aircraft unit costs and permit greater production with the same resources. It should increase the competence level in aircraft manufacturing, reduce local and regional employment fluctuations and stabilize employment at modernized facilities. It could improve the surge and mobilization position of the industry if sized for this contingency.

Arguments - Con

Critics of this alternative cite the superior past performance of the U.S. industry compared to European models, challenge the relevance of experience with foreign licensing of aircraft already in production to direct licensing by design teams to separate production organizations, relate the

difficulty in transitioning from development to production even in an integrated design and production corporation, and note the difficulties experienced by other products that attempted to separate design and production. A rigorous assessment of the potential of either a structural change in the posture of the aircraft industry or the benefits of greatly increased automation has not been made.

D. ESTIMATED FUTURE ANNUAL SAVINGS

In order to develop an estimate of the DoD savings which each of these eight alternatives might generate, knowledgeable DoD personnel were surveyed. Each individual was asked to estimate the order of magnitude or the annual savings which each alternative would generate after five years. Recognizing that there is overlap among the alternatives, each individual was asked to select his preferred grouping of alternatives and to estimate the maximum overall annual savings which could be achieved. The arithmetic means of these subjective estimates, excluding the individual high and low estimates, are shown in the first column of Table 7. The second column shows the range of these estimates. Approximately three-quarters of the estimates lie within this interval.

The third column contains estimates of the perceived difficulty (one being easy, ten being hard) of achieving these savings. Again, the range excludes extremes but includes about three-quarters of the responses. The alternatives preferred by the group were, in order, numbers 4, 3, and 5.

There is considerable overlap among the annual cost savings of the eight alternatives, so that implementation of all of them would not produce a savings of $490 million, the sum of the individual cost savings estimates. The combined achievable savings were estimated to be on the order of $250 million, which was the general consensus of the Steering Committee.

TABLE 7

ESTIMATED FUTURE ANNUAL SAVINGS

	Alternative	"Expected" Annual Savings $ Million	Variation $ Million	Ease/ Difficulty
1.	Current Practice - Evolution	10	0-20	1-2
2.	More Free Market	50	10-80	2-6
3.	Encourage Consolidation/ Contraction	70	10-120	4-8
4.	Efficient Production Rates	100	20-180	3-7
5.	Deliberate Phasing of Procurements	60	0-120	3-8
6.	Shift Depot Activity	30	(-20)-80	5-9
7.	Close Government-owned Plants	40	10-70	4-9
8.	Modernize, Stabilize Selected Facilities	130	50-210	6-10

E. IMPLEMENTATION ACTIONS

In addition to the policy alternatives discussed above, some immediate near-term, programmatic, and long-term implementation actions that might be used to carry out the various policy alternatives were identified but not examined in detail. Subsequent examination of these actions, except the immediate ones, should be performed prior to their enactment. These actions are:

Immediate

- Release report of study to industry.
- Establish resource planning group for follow-up action on this and other defense industrial base studies.

Near-Term

- Terminate, or efficiently buy out and then terminate, low-rate production programs.
- Limit maximum allowable overhead rates on contracts.

- Disapprove further plant expansions.
- Close or mothball several government-owned product centers.
- Postpone or redirect currently planned overlapping developments.
- Identify selected depots to be closed and transfer the displaced work to private industry.
- Remove critical choke points to surge capability.

Programmatic

- Phase programs in each sector so as to smooth aircraft procurement variations.
- Plan production rate changes to minimize work force turbulence.
- Consider production site/facility factors during competitive development phase planning.
- Review procurement plans early in the development phase to improve facilities utilization and to insure efficient industry production labor loading.
- Limit award of prime production contracts and major subcontracts to firms with viable facility, tooling, and management assets.

Long-Term

- Institutionalize systematic aircraft industry resource planning.
- Take procurement and policy actions to promote desired industry contractions.
- Establish specialized suppliers for critical or high technology components or materials.
- Assess the potential benefits of producing military aircraft in selected, highly modernized, fully loaded aircraft plants.

Annex A

DEPARTMENT OF DEFENSE

AND

OFFICE OF MANAGEMENT AND BUDGET

Aircraft Industry Capacity Study Plan

6 August 1976

6 August 1976

AIRCRAFT INDUSTRY CAPACITY STUDY

PROBLEM

It appears the aircraft industry has a production capacity significantly in excess of present or likely future requirements. It has been suggested that the cost of maintaining this excess capacity is out of proportion to the benefits this excess capacity provides. Others argue that this excess capacity is very desirable for both competition and surge capacity.

The FYDP and POM-78, in some cases, indicate some relatively low rate aircraft production quantities. Low rates, spread among several aircraft and component prime contractors, imply an inefficient use of resources, uneconomical budgetary costs, and sacrifice of other important DoD programs. These conditions, within the FYDP framework, suggest unused and possibly excess capacity carrying cost to DoD. At the same time, the Military Departments have not established under current defense planning guidance scenarios their quantifiable surge and/or wartime net needs against which the capability of existing/projected capacity can be measured. The problem is further complicated by the considerable DoD in-house facilities and service contractors which vie with the airframe industry for modification work. Some manufacturers assert that the DoD in-house efforts detract from the industry base.

PURPOSE

This study will assess the capability of the U.S. aircraft industry to manufacture and logistically support (through spare parts and modifications) helicopters and fixed-wing aircraft in terms of projected national civilian and military needs. It will determine the production capacity presently available and compare it with that required to meet the demands of present

and future military, civilian, foreign military sales and surge requirements. Industry limitations such as bottlenecks and choke points will be identified and assessed. Should the results show that capacity in excess to these requirements exists, the advantages and disadvantages of feasible alternatives will be explored for bringing the capacity into cost effective alignment with projected needs. Associated changes in government policy in pursuit of these alternatives will be constructed.

METHODOLOGY

This study will be initiated by a review of available literature and documentation on aircraft industry capacity and aircraft requirement projections. Data and recent studies conducted by or under the auspices of the Department of Defense, the Department of Commerce, the Department of Transportation, the aerospace industry associations (AIA, GAMA, etc.), and other organizations as appropriate will be examined. The point of departure for this study will be the data base and results of System Planning Corporation (SPC) ongoing efforts in assessing government policy influences on the aircraft industrial base. Knowledge, views and experience of government agencies will be fully exploited. This study will concentrate on the advantages and disadvantages of alternative policy initiatives. Aircraft industry capacity will be defined and then measured using several parameters such as sales, employment, manufacturing floor space, capital equipment, AMPR weight, etc.

The relationship of direct to indirect overhead costs will be explored to distinguish between necessary and hard core activities, and those not providing a direct benefit to the government. Capacity and cost should be separately identified for research, engineering development, production and modification for both the government and private sector markets.

This literature review will be used to prepare a perspective and comparison of capacity and projected needs for Steering Group review and critique. This initial review will include identification of alternative courses of action to balance capacity and needs.

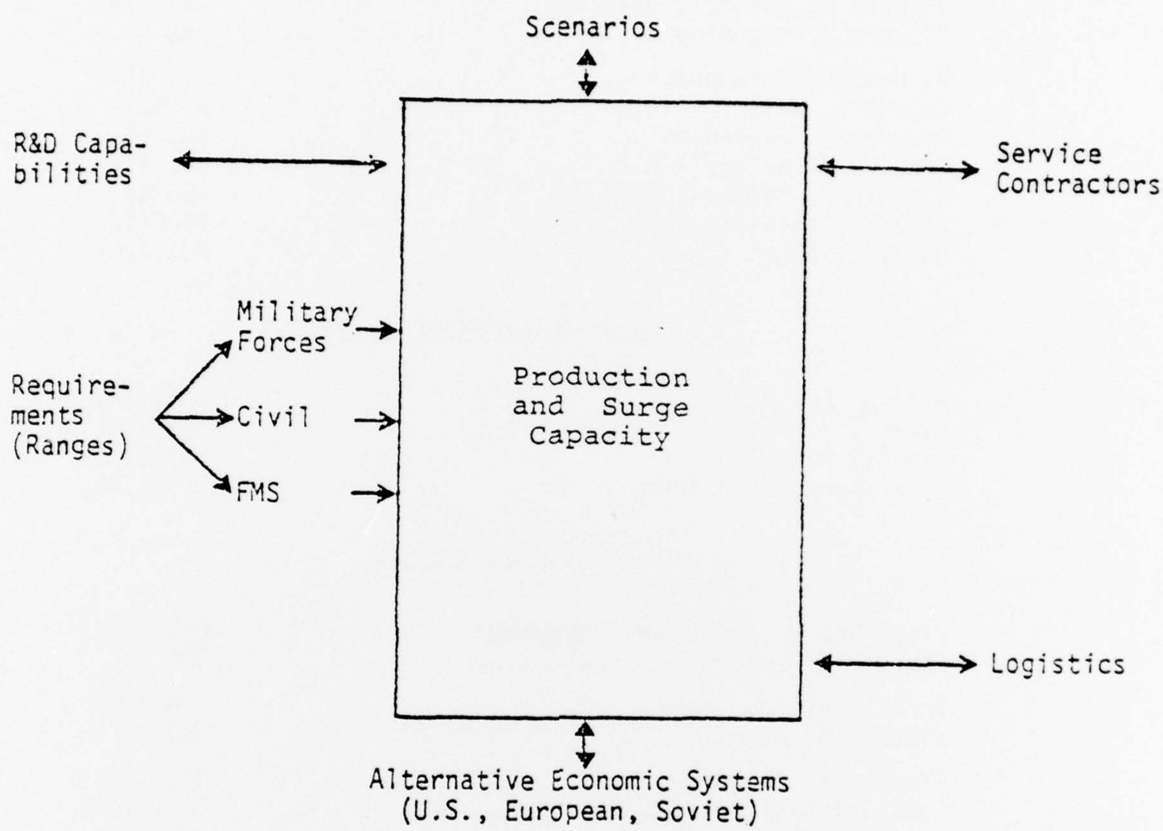
The perspective of capacity will then be refined according to guidance of the Steering Group, and measures of the cost of idle capacity will be derived. The distribution of the cost burden of this capacity among civilian, military and foreign customers of the industry will be analyzed. The beneficial aspects of excess capacity both social and financial will also be identified and assessed.

A list of feasible government policy alternatives that address the problem of excess capacity will be developed and implementation procedures described. The advantages and disadvantages of implementing these alternative policy initiatives will be analyzed and refined. These analyses will include direct and indirect costs and assessments of intangible considerations such as the relationship between excess capacity and competition. The subjective assessments will be supported by data weighed for significance by the Working Group and the Steering Group.

New policy and changes in existing policy required at the Departmental and National levels to implement and/or promote alternative courses of action will be identified.

The study will conclude with: (1) a brief report and a supporting presentation to and for the use of the Secretary of Defense and the Director of the Office of Management and Budget, and (2) a final report to the President.

METHODOLOGY MODEL



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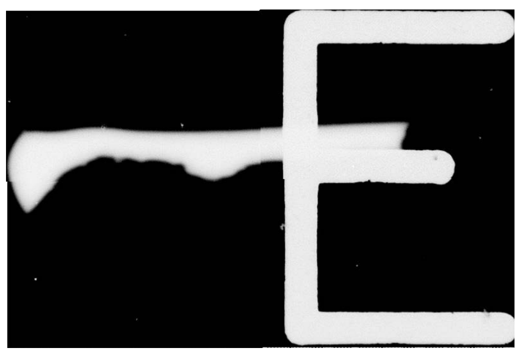
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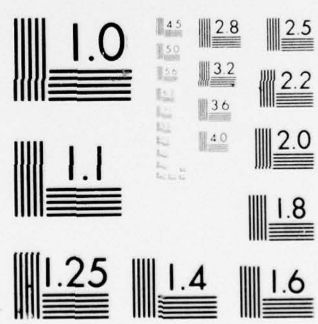

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

SUPPLEMENTARY

INFORMATION

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OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE
WASHINGTON, D.C. 20301

MANPOWER,
RESERVE AFFAIRS
and Logistics

17 MAY 1977

Defense Documentation Center
c/o Defense Supply Agency
Cameron Station
Alexandria, Virginia 22314

SUBJECT: Aircraft Industry Capacity Study - Correction

Enclosed please find revised page 23 to the Aircraft Industry Capacity Study report previously forwarded. This change corrects the footnote to Table 5 of the report.

Attachment

Frederick W. Myers, Jr.
Director
Weapon Systems Production
Management
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AMERICAN REVOLUTION BICENTENNIAL 1776-1976

U.S. manufacturing industries as technological innovations lead to greater productivity increases for production workers than for indirect workers. Both these trends are reflected in Table 5.

TABLE 5

PRODUCTION AND NONPRODUCTION EMPLOYMENT IN THE AIRCRAFT INDUSTRY

Year	Number of Airframe Production Employees (1000s)	Number of Airframe Nonproduction Employees (1000s)	Ratio of Nonproduction to Production Employees	Constant Dollar Sales ($ billions)
1961	155	125	0.81	12.3
1962	155	141	0.91	12.4
1963	152	137	0.90	10.7
1964	155	126	0.81	11.3
1965	162	129	0.80	12.0
1966	215	158	0.73	15.8
1967	244	175	0.72	18.8
1968	248	182	0.73	21.4
1969	221	175	0.79	18.2
1970	168	147	0.88	17.0
1971	131	125	0.95	14.0
1972	127	120	0.94	11.0
1973	127	121	0.95	12.6
1974	125	120	0.96	12.3
1975	114	121	1.06	12.1

Source: Employment numbers and sales are from data provided by the aircraft companies. Employment ratios were derived from Aerospace Facts and Figures 1976/77.

In the peak employment years of 1966 to 1969, the industry operated at an average ratio of 0.75 nonproduction employees for every production worker. Ignoring relative productivity changes for the moment, this compares with a ratio of 0.80 to 0.90 in the lower activity levels between 1961 and 1964 and 0.95 to 1.06 in the low capacity utilization years of 1973-1975.

Converting the 1966-1969 ratios to a 1975 figure and adjusting for productivity changes since that time, the average figure of 0.75 becomes 0.81 in 1975. This productivity adjustment assumes that the industry average